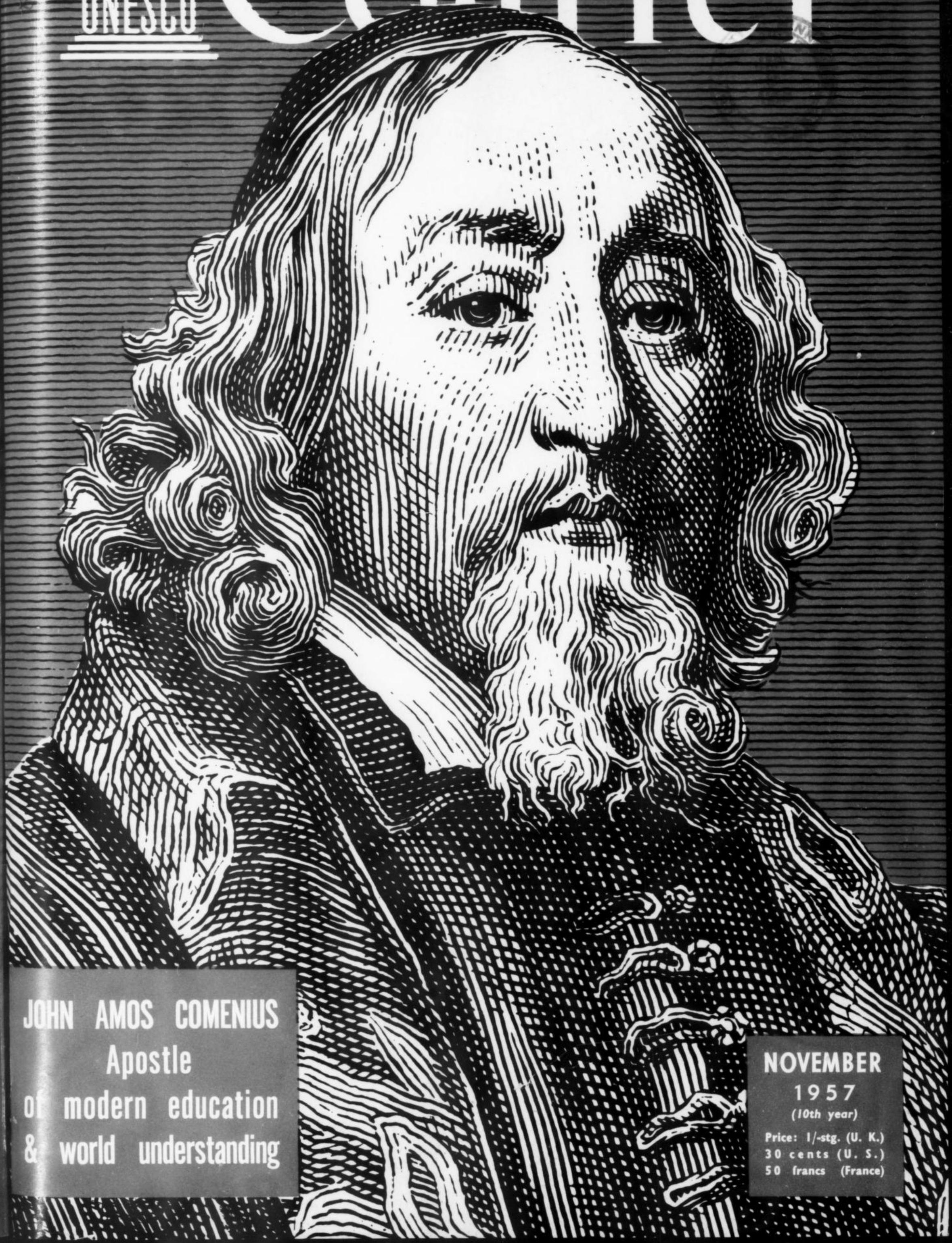
A WINDOW OPEN ON THE WORLD

The UNESCO Courier



JOHN AMOS COMENIUS
Apostle of modern education & world understanding

NOVEMBER
1957
(10th year)
Price: 1/-stg. (U. K.)
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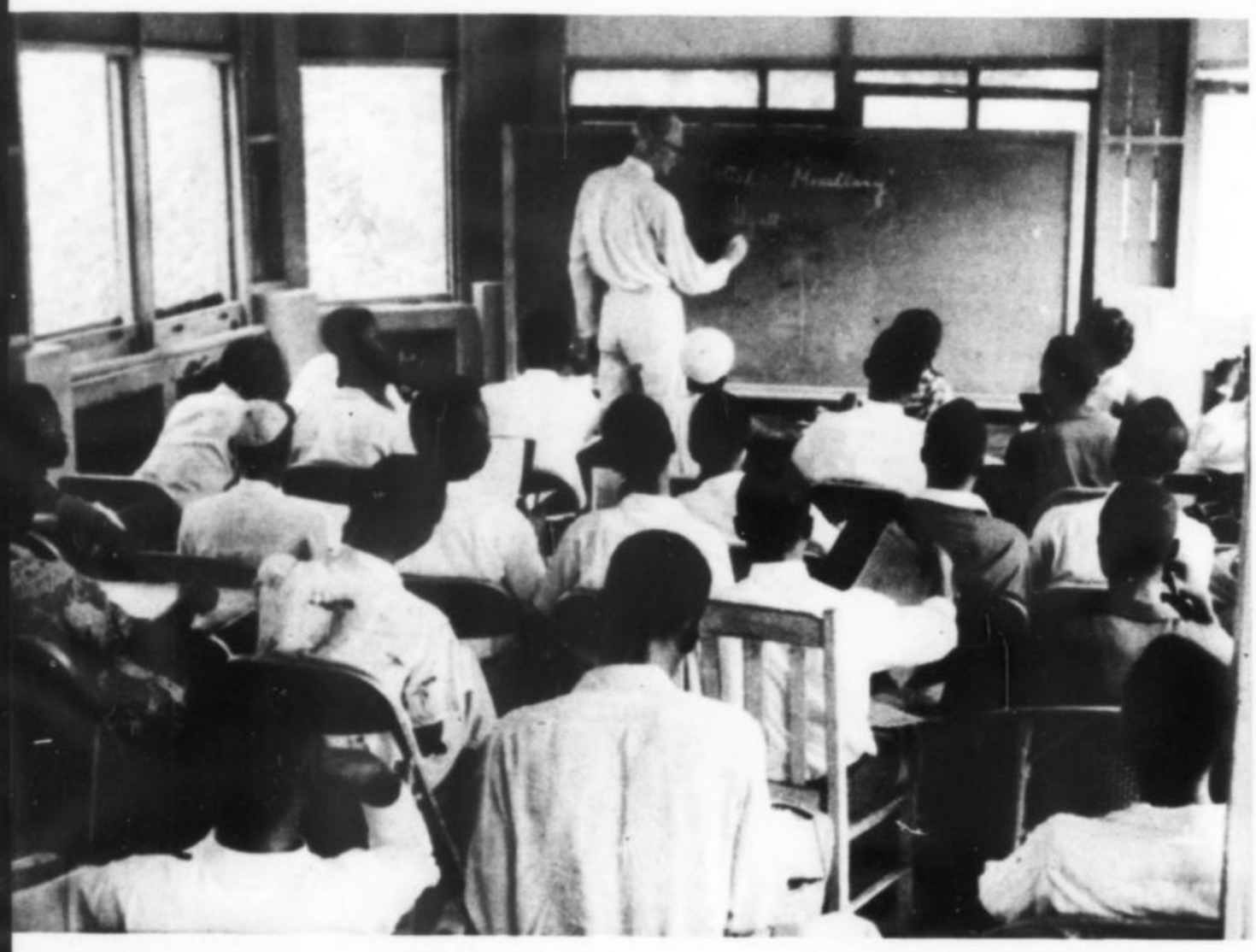

REVOLUTION IN LIBERIA'S SCHOOLS

Thirty miles west of Monrovia, capital of Liberia, lies the village of Klay—the end of a two-hour jeep ride over dirt roads and through jungle fords. Klay reckons its population simply as "two hundred and fifty huts", but it is the capital of a district where a slow revolution in education is taking place. Since 1952 it has been the centre of a joint Unesco-Liberia project to introduce modern methods of fundamental education—from health and hygiene measures, agriculture, reading and writing, to needlework, domestic science and homecraft—into the district's bush villages. Above, two of Klay Centre staff discuss the building of a school with the people of Godi, a typical bush village. Under its technical assistance programme Unesco has also sent specialists to form the nucleus of the new science faculty at the University of Monrovia, and has organized a teacher training programme. Left, students attending a teacher training course at the University. (See page 27)

Photos UNESCO-Eric Schwab

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10TH YEAR

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COVER PHOTO

Unesco pays homage to John Amos Comenius (1592-1670). See below and pages 4 to 15.

Portrait by Max Svabinski.

SPIRITUAL ANCESTOR OF UNESCO

When last November the Czechoslovak delegation to the ninth session of Unesco's General Conference held in the capital of India proposed that this Organization be associated with the celebration of the three hundredth anniversary of the publication of John Amos Comenius' *Didactica Opera Omnia,* by publishing a volume of his selected works, the resolution was voted unanimously not only by the programme commission but by the plenary session of the conference. Such unanimity, rarely achieved in intergovernmental assemblies, is more eloquent than any commentary.

It testifies to the common will of 79 member states of Unesco to celebrate, at the same time as the Czech nation is doing so, a memorable date on which there appeared, among his other works, *The Great Didactic,* today recognized as the first complete presentation of a science of education and the inception of modern theories of teaching.

Why is it that Unesco has deemed it so important to take part in the celebration of this anniversary? It is interesting to quote a few axioms from *The Great Didactic* and *The Pampaedia* (The Education of All) which might well be inscribed at the head of the principal chapters of Unesco's programme.

● "Just as the whole world is a school for the whole of the human race, from the beginning of time until the very end, so all life is a school for every man, from the cradle to the grave." Is this not the Unesco principle of never-ending education, the education of adults as well as youth?

● "First of all, it is essential that all persons learn to read and write." Is this not the motto of the struggle against illiteracy?

● "All young people of both sexes should be sent to public schools." Is this not what Unesco has translated as the development of universal, free and compulsory primary education?

● "No one should be excluded, even less prevented, from pursuing wisdom and cultivating the mind." Is this not the principle of equal access to education and culture, without distinction of race, fortune, creed or social origin?

● And did not Comenius go so far as to conceive of a "Council of Light," an international organization for education, science and culture, which represents a distant prefiguration of Unesco?

These ideas, spread across a receptive Europe three hundred years ago by the great precursor, have lost nothing of their force or their efficacy. But though they are commonly accepted in our time they are far from being an established fact. A gigantic effort still remains to be made, by all peoples uniting their resources, so that they are ultimately applied by all institutions and for all mankind the world over.

It is because his message is still so timely that Unesco, in response to the wish expressed by the Czechoslovak nation, is attempting to make Comenius better known and appreciated. Unesco's contribution on this occasion is designed as an homage of respect and gratitude towards a man whom it recognizes as its spiritual ancestor.

Jean Thomas
Assistant Director-General of UNESCO

COMENIUS

Apostle of modern education and of world understanding

by Marie-Madeleine Rabecq
Curator of the Musée Pédagogique, Paris

JUST three hundred years ago, in 1657, there appeared in Amsterdam the first complete edition of the didactic works of a Moravian bishop-philosopher named John Amos Comenius, regarded by his contemporaries as one of the greatest minds of his epoch.

His *Didactica Opera Omnia,* as the work was entitled was to have the most far-reaching influence on the thinking of educators from the 17th century up to the present day and the principles of his philosophy were to be reflected in the major plans elaborated in the course of the past centuries to achieve peace and international collaboration in the world.

Yet the name of Comenius was to remain practically unknown in most countries for some 200 years. Although a Letter on "Comenius the Humanitarian" by the German thinker Johann G. Herder appeared in 1795, and a few essays were published in Germany, England and the United States between 1828 and 1868 on the life and work of this great educational reformer, little came of these efforts.

It was not until 1871, the bicentenary of Comenius' death, that an international movement of any size took form and resulted in the foundation of the first "Comenius Societies" and the translation of his works into different languages. Since then the name of Comenius has grown steadily in international stature until today he is recognized as the father of the science of education and one of the great apostles of the brotherhood of men and nations.

This year the world of education is celebrating the three hundredth anniversary of the publication of his didactic works, particularly *The Great Didactic.*

In commemoration of this occasion UNESCO has just published a volume containing selections from Comenius' major works (1) ; a film strip on Comenius has been completed for use in schools, and UNESCO's quarterly review *Museum* has published a special study on the Comenius Museum at Uhersky Brod, where he spent much of his childhood and early youth (2). Comenius scholars from many lands recently met in Czechoslovakia at an international congress to reassess the importance of the Moravian thinker in modern life.

The personality of Comenius, his philosophical and educational writings, the influence he has had on modern educational thinking all help to explain the considerable efforts now being made to make Comenius better known to both the general public and specialists alike. The mass of Comenius' writings—our knowledge of which has been greatly enriched by the discoveries of the group now working at the Comenius Institute in Prague—is a highly complex and original body of material from which we have still much to learn. But the guiding ideas of Comenius' system and their true significance are difficult to appreciate fully without some prior knowledge of his life. Comenius' life and work are as closely interwoven as his ideas on world brotherhood and his religious precepts are inseparable from his educational reforms.

Jan-Amos Komensky (Comenius) was born in 1592 in a

Library of the National Museum, Prague

SKETCH OF A TOWN by John Amos Comenius which appeared in his original manuscript of *The Labyrinth of the World and the Paradise of the Heart,* which, in certain respects, has been compared to John Bunyan's *Pilgrim's Progress* — also a 17th century work.

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(1) *John Amos Comenius* (1592-1670). *Selections.* Introduction by Jean Piaget, Director of the International Bureau of Education. The volume is illustrated and contains notes and a bibliography by Professors Chlup, of the Czechoslovak Academy of Sciences, and Patocka, lecturer at Prague University. Besides extracts from *The Great Didactic,* it includes chapters from lesser-known works and also hitherto unpublished ones. Unesco 1957, $3.25; 16/-(stg); 1,000 Fr. fr.

(2) *Museum.* Vol. X, N° 2, 1957. The Comenius Museum, Uhersky Brod.

little town in Moravia (today Czechoslovakia). His father, a miller, belonged to the Moravian Brethren, a Protestant sect following the teachings of Jan Huss, and sent the boy to a parish school at Uhersky Brod. Orphaned at an early age he was shipped off to Stranice, at the time a terribly war-ravaged area, where he was placed in the care of an aunt and began manual training in accordance with the Moravian Brethren custom. It was not until he was 16 that he began his secondary education and learned to read Latin. He later travelled to Herborn in Nassau, Germany, for his higher studies where he worked under the guidance of two remarkable teachers, Johann Fischer and Johann-Heinrich Alsted.

This first period in Comenius' life—the period of his intellectual formation—was to have a decisive influence on his later philosophical and educational views. From the Moravian Brethren he was to learn the deep sense of religion, the dignity of labour and the importance of helping one's neighbour which formed the basis of their doctrine along with their love for their native Bohemia. From Herborn, his efforts to make up for lost school time and his unpleasant memories of the ill-organized schools inspired him to look toward improved methods of teaching and for a school system accessible to everyone.

It was at this period that he conceived the plan for his *Linguae Bohemicae Thesaurus,* "a complete glossary followed by an exact grammar of elegant phrases, figures of speech and proverbs" such as existed in no other language. The ardour of his patriotism and his sorrow at seeing so many of his countrymen neglect the Czech language led him at the same time to compile an encyclopedia which he called the *Amphitheatrum Universitati Rerum.* Thus Comenius while still a young student was instrumental in making Czech a literary language and in this respect his role in his own country can be considered analogous to that of Calvin in France and Luther in Germany.

The Thirty Years' War and its terrible aftermath were to give a new orientation to Comenius' thinking. In 1618 he was serving as pastor at Fulnek, Moravia, when the town was captured and put to the torch. Comenius' manuscripts and entire library were destroyed. Then his wife and children died, victims of a plague epidemic. As a Protestant preacher he was proscribed by the Counter-Reformation party which had triumphed throughout the lands of the Bohemian crown. For ten years he lived in hiding in remote districts of Bohemia, before leaving his country for ever.

Accompanied by Moravian Brethren followers he fled to Poland, taking refuge in the town of Leszno where he was named headmaster of the secondary school. It was at Leszno that he began his extensive

Cont'd on next page

Bibliothèque Nationale, Paris-UNESCO filmstrip, "Comenius"

1657-1957. A great collection of didactic works entitled *Didactica Opera Omnia* was published in Amsterdam in 1657. The works had been written some thirty years earlier in the Czech language by J.A. Comenius, while the author was still living in his native Moravia. This year the third centenary of the publication in Latin of this volume is being celebrated throughout the world. (Below, an original copy of the volume). Comenius was one of the first men to propagate the ideas which Unesco took for its guidance at the time of its establishment. Above, frontispiece of the volume drawn by Crispin de Pas. To commemorate this third centenary, the Czechoslovak Government has minted a special coin, both sides of which are reproduced, above left & opposite page. (Comenius is the Latin version of Komensky)

C.T.K.-Leos Nebor

COMENIUS
(Continued)

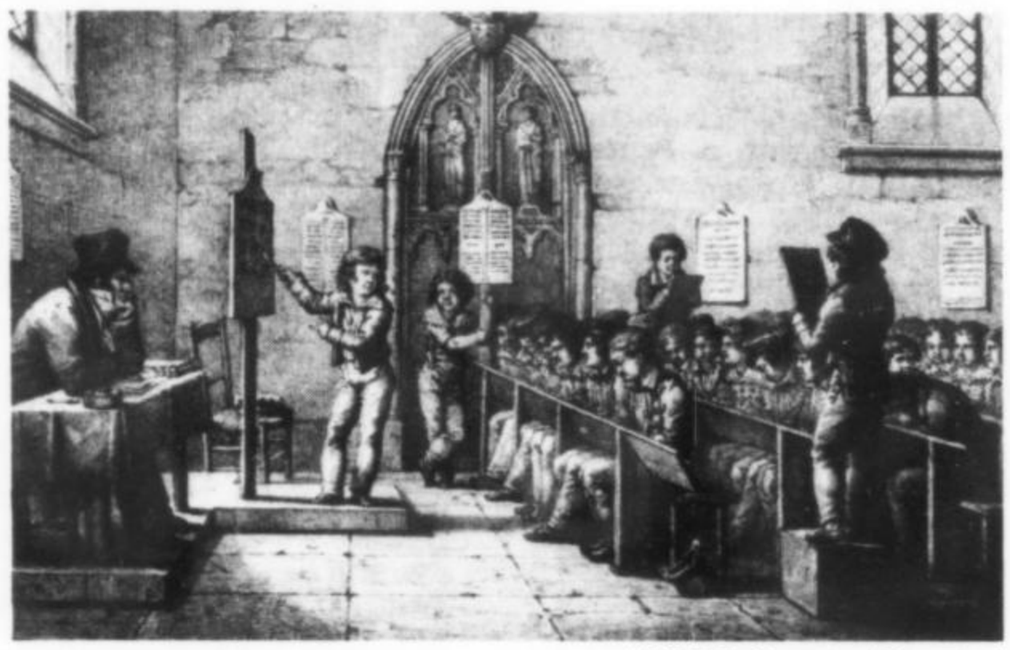
He did not fear to assert: 'Spare the rod—improve the child'

correspondence with scholars in foreign countries and wrote some of his major works. In addition to *The Great Didactic,* he produced the *Labyrinth of the World and the Paradise of the Heart,* a *Guide for Infant Schools,* and his *Ianua Linguarum Reserata* which was so successful that it was translated into twelve European languages, into Arabic, Turkish, Persian and Mongolian, and soon won him world renown.

He was working on his *Prodromus Pansophiae* (a work on education which attempted to organize all human knowledge within the reach of everyone, and which attracted the attention of Descartes) when he was invited to go to England by Parliament to set up a College of Universal Knowledge. But fate seems always to have been against him. When he arrived in London, England was on the verge of civil war and he found that the project had been put off by Parliament. Comenius then accepted another offer to reform Swedish schools which he had received from a Swedish philanthropist, Louis de Geer, who was to be his lifelong patron and friend. Again dogged by misfortune, however, he resumed his wandering life.

Named Bishop of the Moravians, Comenius returned to Leszno, but in 1650 left for Saros Patak in Hungary where he hoped to found a pansophic college. He worked out a plan for educational reform but his efforts were frustrated by the lack of appropriate textbooks and the shortcomings of teachers and students alike. It was at Saros Patak, however, that he wrote his famous *Orbis Pictus.*

After a further period at Leszno, during which he again lost all his property, Comenius, now 65, once again took up his pilgrim's staff and set off for Amsterdam by way of Stettin and Hamburg to stay with Laurenz de Geer, the son of his former patron.



UNESCO filmstrip, "Comenius"

THE MASTER WILL STAND BEFORE THE CLASS on an elevated platform, keeping the scholars in his sight, allowing none of them to do anything but attend and look at him. Just like the sun he will send his rays over them all, while the scholars must direct their ears, eyes and thoughts towards him, and attend to everything that he tells them by word of mouth or explains by means of his hand or of diagrams. This, in part, was the solution proposed by Comenius to the problem, "How can a single teacher teach a number of boys, no matter how great, at one time?" In this engraving of an early 19th century classroom the top-hatted teacher has brought out a pupil to continue the lesson.

It was during this last stage of his life that he succeeded in publishing his complete didactic works under the title *Didactica Opera Omnia ab anno* 1627 *et* 1657 *Continuata.* At the head of the great collection, Comenius placed his monumental *Didactica Magna* or *Great Didactic.* First written in Czech, Comenius later translated *The Great Didactic* into Latin. It is this version which first appeared in print in 1657.

On November 15, 1670, Comenius died at Naarden, in the Low Countries at the age of 78. He had written more than 140 works, travelled the length and breadth of Europe, discussed his ideas with Descartes and Hartlib, formed groups of disciples around him, and never relaxed in his effort to apply everywhere he went the great principles he had evolved during his lifetime.

Comenius' great principles concerning education, stem naturally from his conception of the world. For Comenius, as for Rousseau a century later, man is capable of infinite perfection, and education is the path that leads to his development. Comenius believed that the one sure way to the heart and confidence of a child was through love; that the one sure method of success in teaching was the observation of nature and respect for its laws. He advocated that school lessons be carefully adapted to the different aptitudes of children and that a child's spontaneity and dignity be fully respected. Whereas Erasmus did not hesitate to recommend the use of the rod (and even John Locke praised it as an educational instrument) Comenius denounced corporal punishment at a time when it was so widely practised and so rigorously administered that schoolchildren were sometimes left permanently crippled.

Comenius did not envisage education only at school. He saw it as beginning in early infancy, "the age when learning is absorbed most naturally" and described the education of pre-school children in his *Informatorium (Guide for Infant Schools).* His *Great Didactic* and other textbooks were designed for different school ages, and he arrived, finally, at the conception of all human life as a school, calling it the *Pampaedia* (The Education of All).

Comenius went on the postulate that children are malleable and flexible beings, that as they develop in body and mind their horizons can be continuously enriched and expanded, but that to develop a real sense of awareness the teacher must start with those elements which the child's senses can grasp, and attempt always to associate "the word and object referred to." "Words," he said, "should be taught and learned only in association with things—for what are words but the husks and coverings of things?"

"Whenever instruction is given in any language, even though it be in the mother tongue itself," Comenius wrote, "the words must be explained by showing the child the object denoted. On the other hand, everything that the child sees, hears, touches or tastes, he must be taught to express in words, so that the command of language and development of the mind progress uniformly side by side." Thus Comenius in the 17th century challenged the sterile verbalism prevalent in the schools of his time, and was a forerunner of sensory education which has achieved notable results in our own day.

Since the acquisition of all knowledge presupposes some effort of attention on the pupil's part, the Czech educator stressed the idea that the child's attention would be spurred by his natural interest in his immediate surroundings and therefore condemned exercises in a vacuum in favour of activity based on interest. "Do not undertake any teaching," he wrote in his *Great Didactic,* "without first arousing the interest of the pupil." And again: "Always offer something which will be both agreeable and useful; the pupils' minds will thus be primed and they will come forward eagerly, with ever-ready attention."

The development of the mind, Comenius said, is based on a love of learning. "Before setting about making of his pupil a

Cont'd on page 13

Bruegel · Inuentor ·
COCK · EX · 1557
PARISIOS STOLIDVM SI QVIS TRANSMITTAT ASELLVM · SI HIC EST ASINVS NON ERIT ILLIC EQVVS ·
Al reyst den esele ter scholen om leeren ... ist eenen esele hy ey sal gheen peert weder keeren

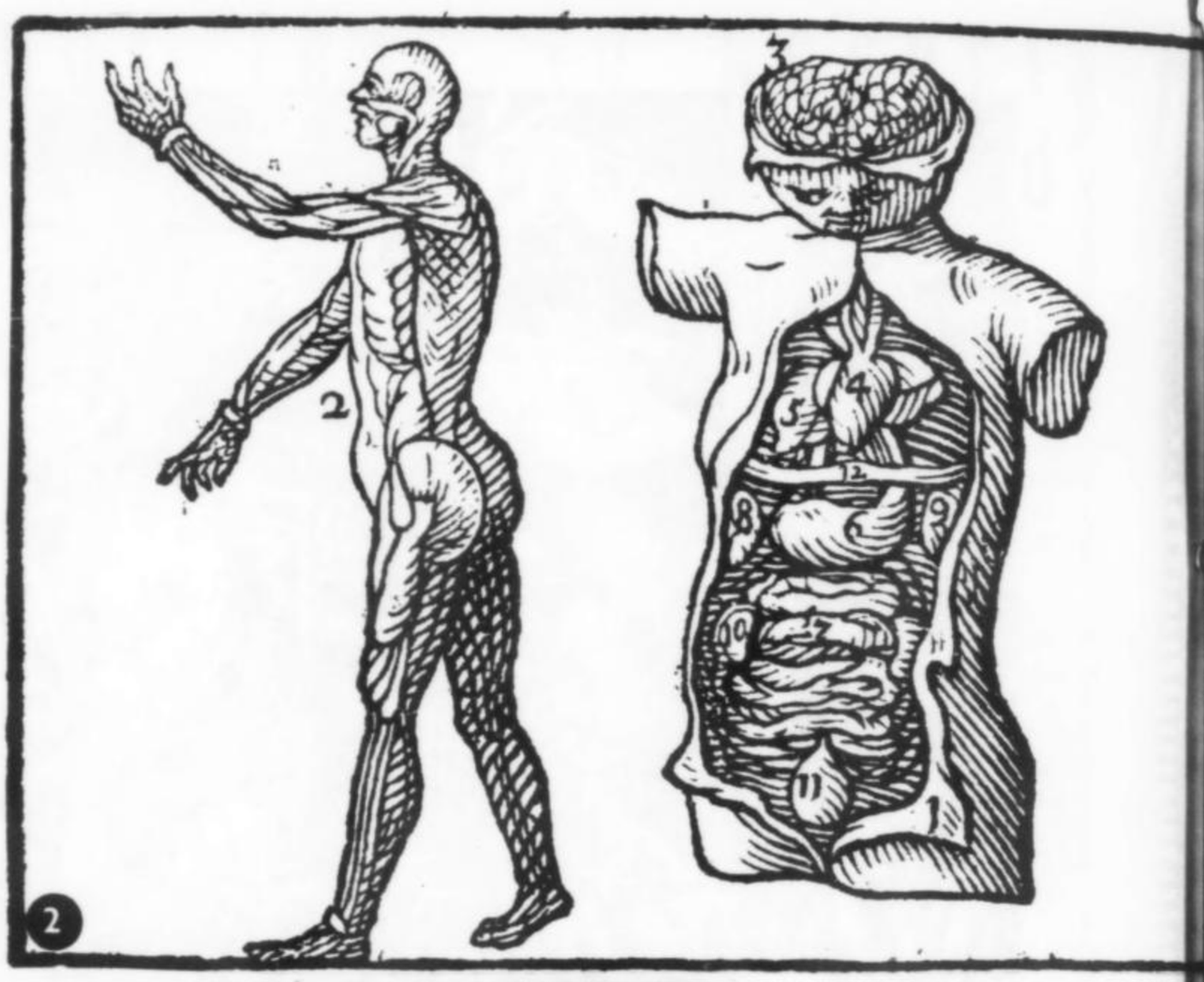
UNESCO filmstrip, "Comenius"

CHAOS IN THE CLASSROOM. In Comenius' day, schools were not very different from the disorderly, unmethodical institutions satirically depicted by Breughel the Elder in his "Donkey in the Classroom", about a century earlier. Realizing that the situation could not be remedied permanently by changes of detail, Comenius conceived and wrote *The Great Didactic* as a science of education. Though he does enter fully into practical details he handles his subjects systematically. A school, he said, should as far as possible be in a pleasant spot, green and shady with gardens or trees and decorated with pictures. In school architectural design and decoration today, (as shown by classroom below) the great educator's ideas have come to fruition.

THE 'ORBIS PICTUS' WORLD'S ORIGINAL PICTURE TEXTBOOK

Comenius was responsible for a brilliant innovation when he added pictures to some of his books and directly linked word and image for education. His most outstanding work in this field was the *Orbis Sensualium Pictus*, an original kind of illustrated encyclopedia of human knowledge in the early 17th century. To illustrate two of its chapters entitled "God" and "The World" he used the engravings on the opposite page (6 and 7). Numbering of the details in each picture made the *Orbis Pictus* a school textbook of a kind hitherto unknown. In the chapter on "metals", for example, each object depicted in the drawing on the left-hand page (4) bears a number which corresponds to the numbers and descriptions on the opposite page. As this example shows, the *Orbis Pictus* was also an illustrated Latin-German lexicon. The two engravings from the chapter on "Man" (2 and 5) show that this linking of the objects and their descriptions was often done in great detail. For the teaching of anatomy, Comenius was a firm advocate of the maxim "seeing is believing". He called for "ocular demonstrations with organs such as intestines, lungs, the heart and the liver, made of leather and stuffed with wool". Plastic cutaway models of the human body and its organs (1 and 3), which can be taken apart and handled by the class, are modern versions of those proposed by Comenius. Explaining how a dummy human body could be built for teaching purposes, Comenius declared: "If you take the student of medicine to this construction and explain each part to him separately, he will grasp all the details without any effort, and from that time forth will understand this mechanism of his own body."

Illustrations taken from the UNESCO filmstrip, "Comenius"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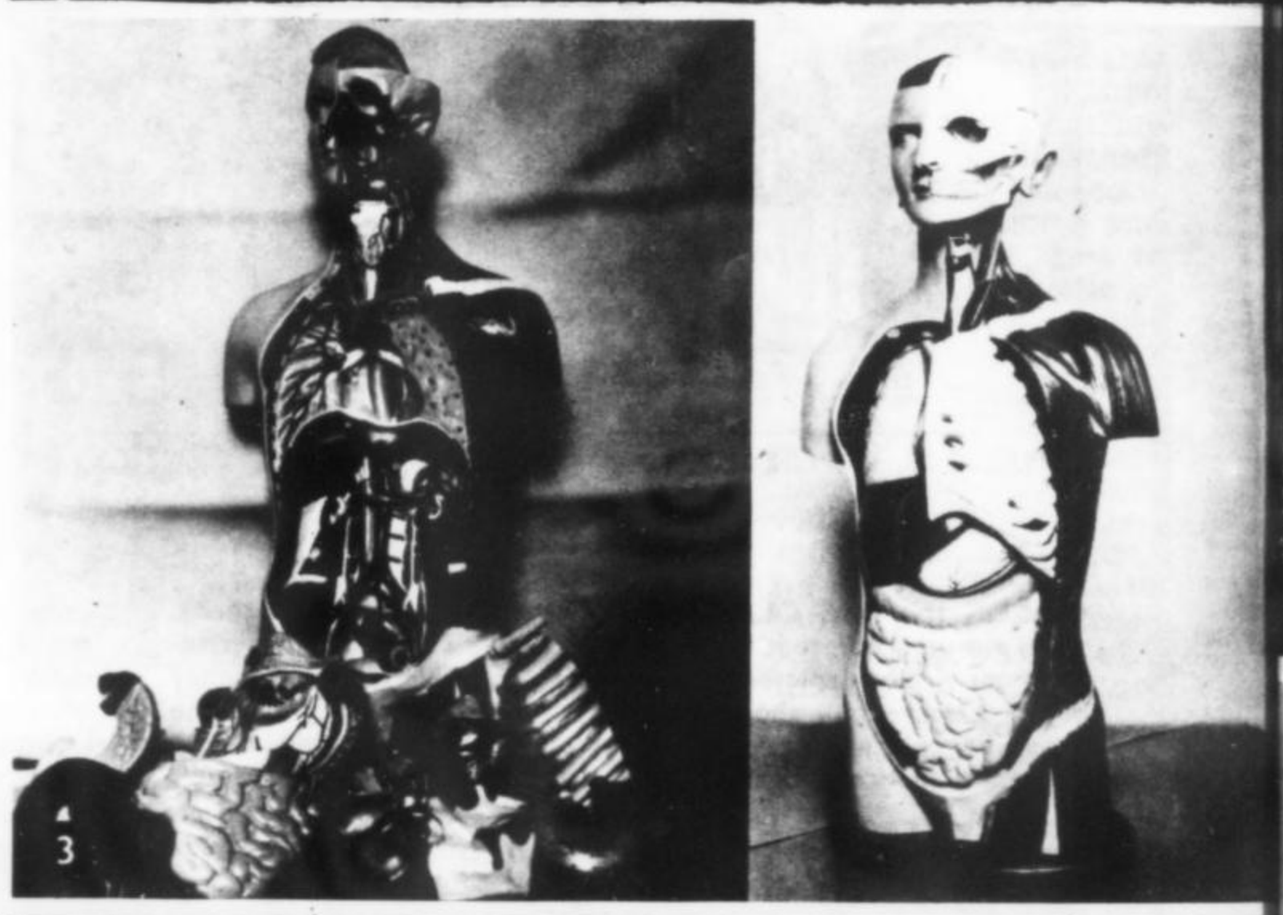
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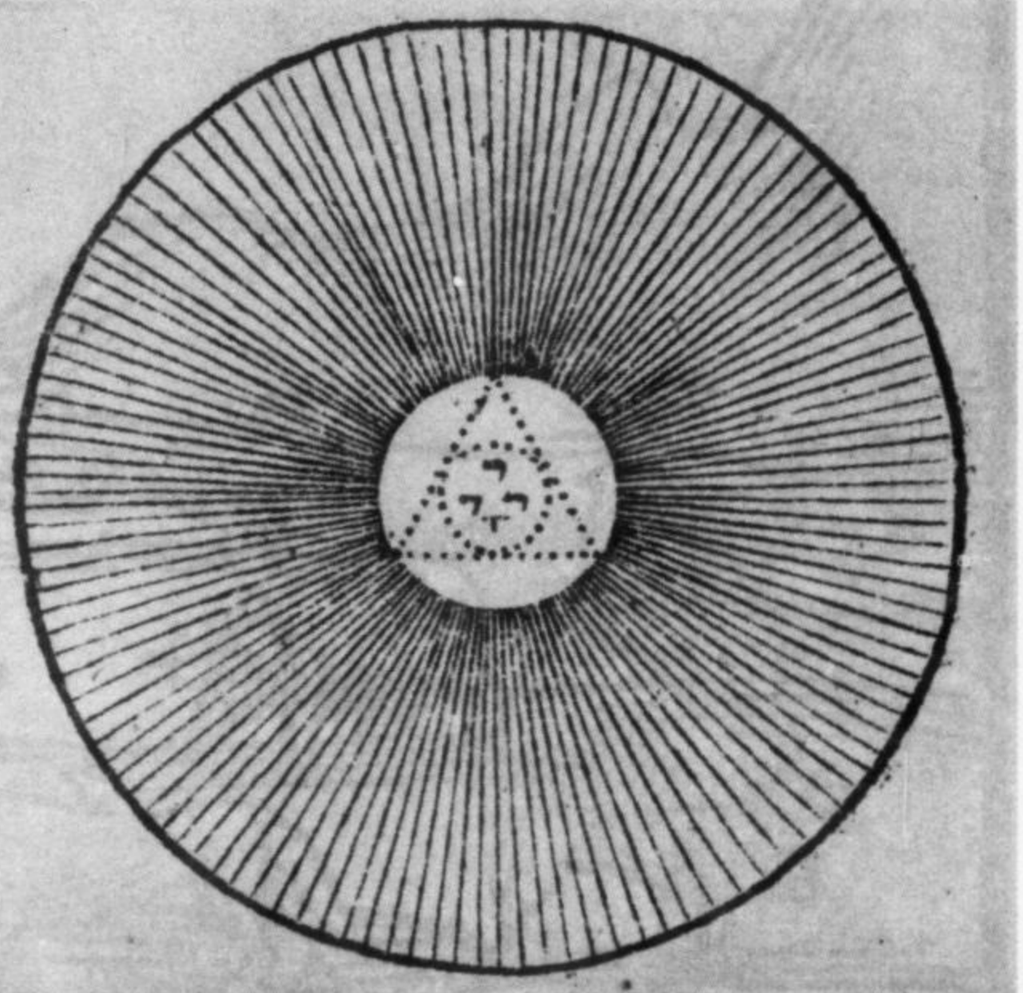
© Bell Laboratories' Record

Mundus.

Die Welt.

DEUS. GOTT.



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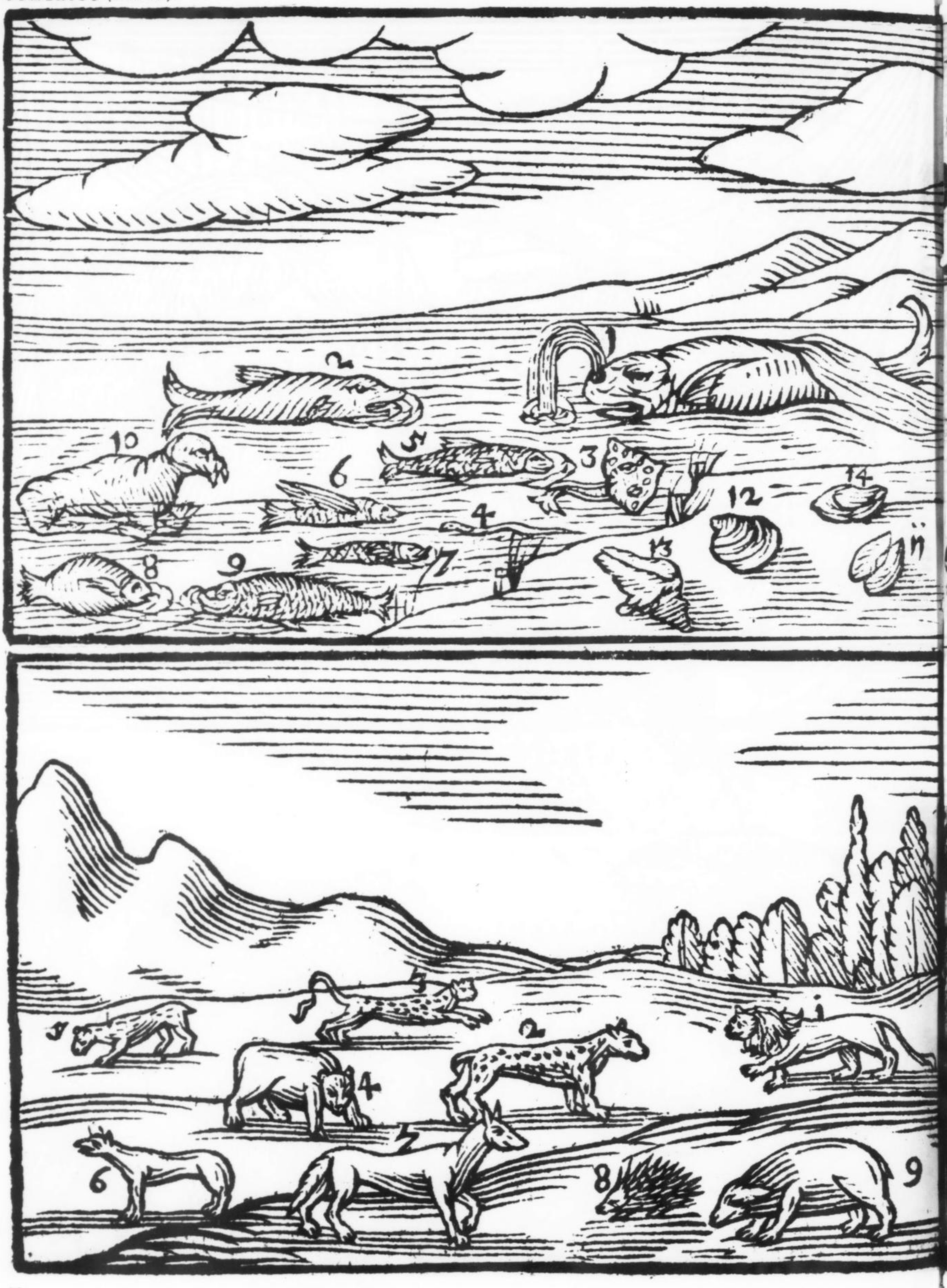
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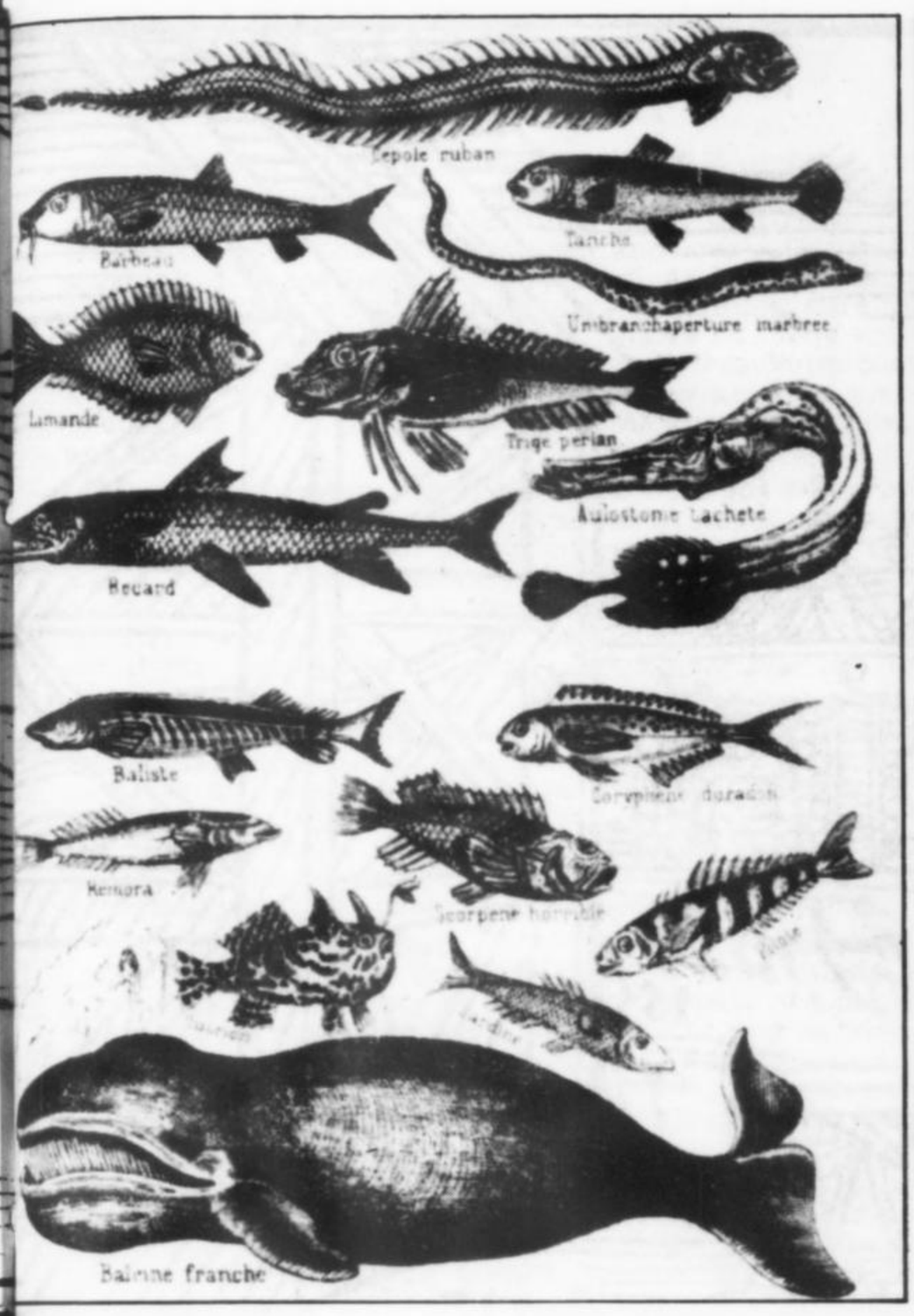
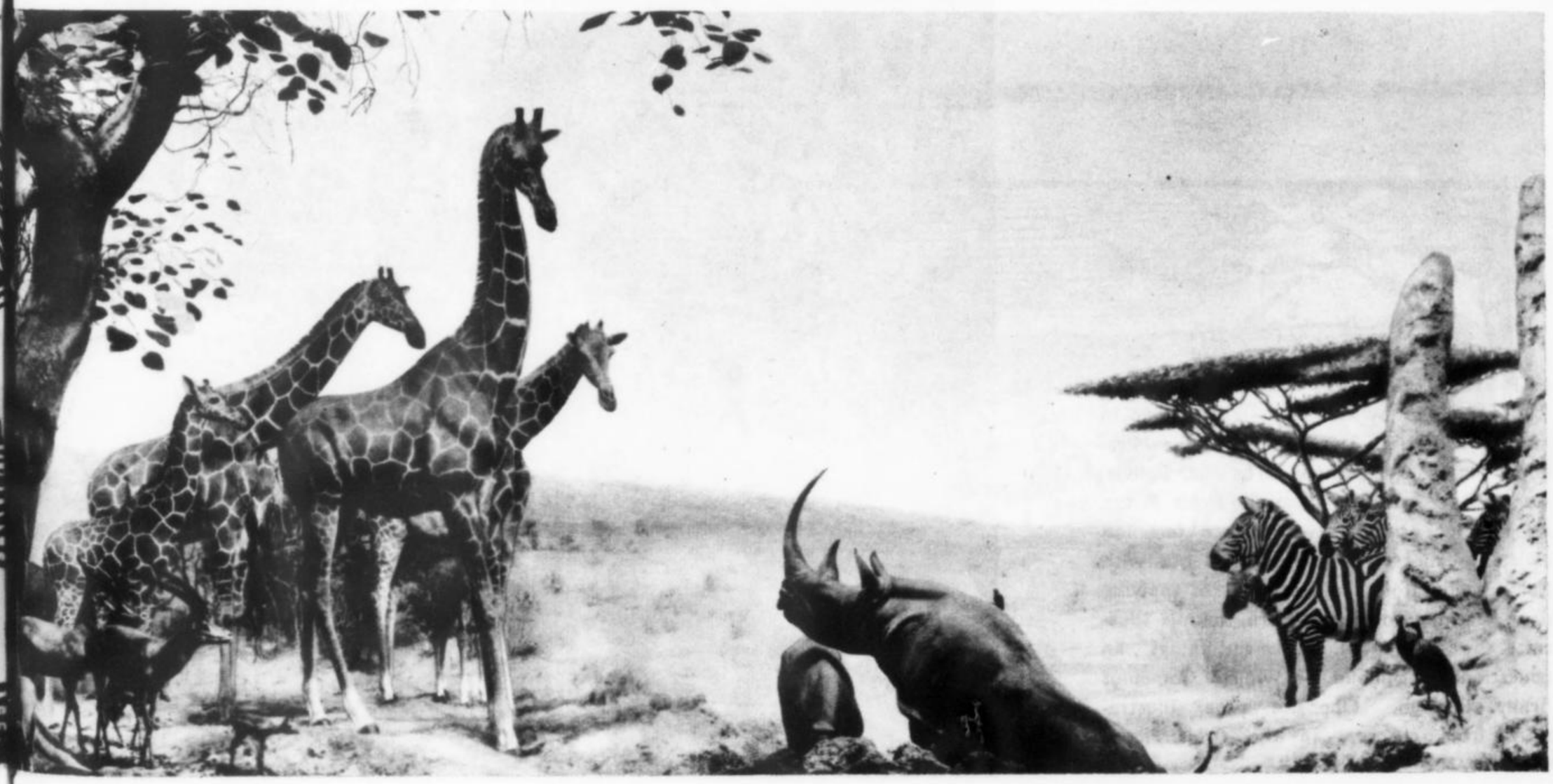


UNESCO - filmstrip, "Comenius"

WORDS ARE BUT THE HUSKS OF THINGS

"Words," said Comenius, "should always be taught and learned in combination with things... just like a tree with its bark and a fruit with its skin. For what are words but the husks and coverings of things?" In his illustrated textbook, *Orbis Pictus*, he outlined a system for teaching children to read which resembles the "global method" widely used today. Following this system, the first pages of *Orbis Pictus* show drawings of different animals and alongside each one the noise it makes. Modern education has absorbed much of his system. Opposite page, two engravings from the same work. Above, left, illustrations from a present-day textbook. Modern out-of-school lessons such as visits to places of interest (above, right) were also recommended by Comenius: "In Spring they may be taken into the garden or into the country and taught the various species of plants, vying with one another to see who can recognize the greater number." Below, in a Chicago Natural History Museum showcase, scientists and artists have skilfully recreated the natural habitat of the animals, thus giving a "real life" emphasis to the exhibit.



UNESCO filmstrip, "Comenius"

FAR-SIGHTED DOCTRINES advocated 300 years ago by Comenius, are applied in modern education. Right, a class in the Miraflores pilot-project school at La Paz, Bolivia. Above, an illustration from the *Orbis Pictus*. At Miraflores school two Unesco technical assistance specialists have worked out with Bolivian educators the best ways of applying new teaching methods. Here, murals illustrate the "linking of words and things", an educational technique on which Comenius firmly insisted. Opposite page, illustrations from chapters in the *Orbis Pictus*.

UNESCO

COMENIUS (Continued from page 6)

well-cultivated mind by cramming him full of rules, the teacher should make him eager for learning, and better still, capable of receiving learning. But who takes the trouble of doing this with kindness and love? Generally speaking, the teacher takes his pupil as he finds him, each one setting about at once turning, tanning, carding, weaving and modelling him as he thinks fit. The child is expected immediately to become a well-formed product, a polished jewel. And if the miracle does not take place in a hand's turn... the teacher grows indignant and storms and rages."

Comenius therefore emphasized the need for attractive lessons given in pleasant and harmonious surroundings by teachers who were both gentle and understanding. This was a far cry from schools "littered with fragments of blood-stained birch" and resounding with "the cries of children tortured by rage-impassioned masters" one horrifying description of which Montaigne has left us.

In this new type of school, set amid gardens where the children "will enjoy the beauty of the trees and flowers," Comenius pioneered a system of progressive education adjusted to the stage of development of each pupil. He distinguished four different schools or "cycles in which the children would be separated according to age," and which we should now call the four major periods of education : infancy, childhood, adolescence and youth.

But Comenius did more than this. With remarkable intuition, he grasped the fact that the same forms of knowledge are necessary at the different levels, the difference between the levels lying mainly in the way in which the forms of knowledge are presented. Thus each stage of learning covered a complete field of knowledge with each succeeding stage going deeper and covering a wider area.

"Though these schools be different," Comenius wrote, "we do not wish them to teach different things but rather the same things in a different manner. I mean, all things which can make men truly men, and the learned really learned; they should be taught in consideration of the pupil's age and the standard of his prior preparation, which should always tend gradually upward."

Open up the living book of the world !

COMENIUS' idea of progression by "concentric circles" was based on the precept that the first step in training the mind was instruction in the elementary principles essential for acquiring "universal knowledge". His aim was to get his pupils to believe nothing without prior reflection and to do nothing without prior reasoning. As he put it, the aim of education was not only the acquisition of knowledge but also the development of character, the training of judgment and the progressive awakening of sensibility.

"Let no man exhaust his desires, his senses and his energy, submit to the desires of others, subordinate his feelings to those of others or let himself suffer compulsion from without," he said. "Each of us must realize that he bears his own happiness within himself."

Having thus so clearly defined the spirit and aims of education, Comenius then went on to seek the methods to be used. His suggestion: one which "will enable the teacher to teach less and the pupils to learn more." Since children were capable, in the eyes of the 17th century educator, "of examining everything by themselves without surrendering to adult authority," their education should be based on direct activity methods. The pupil's role should be to search, discover, discuss and repeat; the teachers' merely to supervise and guide them in their efforts at discovery. He recommended that the teacher should take his students on visits to manufactories and on field trips to study the land, plants and animals. In this way, he said, "the children will be engaging in studies which will give them as much pleasure as if they had spent the day playing games."

Children should study nature whenever possible, Comenius said, for "instead of studying dead books, why not open the living book of the world, the study of which offers us more pleasure and benefit than any person could ever give us? ... Men should learn by studying the sky and the earth, the oak trees and

Cont'd on next page

COMENIUS
(Continued)

Theologian enamoured of metaphysics, patriot seeking a union of nations

the beech trees." The objects referred to should be actually shown to them ; anatomy should be taught by dissection. And when it is not possible to show pupils the real viscera they should be given "ocular demonstrations, of livers, lungs, intestines, etc., made of leather and stuffed with wool."

The textbooks of Comenius are conceived in this same spirit. Two are of unusual importance: his *Gate of Languages Unlocked,* already referred to, and his *Orbis Pictus* (The World in Pictures). Though not the world's first illustrated textbook it is the first school book in which the pictures are not merely illustrations added for attractiveness and interest but basic to the whole conception of the work. In this sense Comenius is the father of the illustrated textbook.

The *Orbis Pictus* is a great pioneer work for other reasons too. Comenius shifted the emphasis in instruction from words to things, and taught language by means of pictures. The book tied the thing, shown in the picture, with the word forming part of a sentence, passing from word to thing to new word. Furthermore it provided the Latin words and sentences and their translation side by side. The subject matter was not the world of classical antiquity but everyday, useful information and scientific knowledge. Comenius thus broke completely with the sterile traditions of Ciceronianism that afflicted the schools of his time and for hundreds of years afterwards, and abandoned the method of teaching language by grammar and by rule.

Young scamps no longer raised the devil

"THIS book," he said, "will provide small children with a marvellous device for learning to read with far greater ease than heretofore." He explained that he intended to use the *Orbis Pictus* as a miniature encyclopedia serving as both a primer and a lexicon for learning Latin and German. His device was a picture alphabet in the form of animals followed by individual letters imitating the sounds the animals make. In this way, he said, a child "only just beginning to learn the ABC or to spell will bethink himself and immediately call to the mind the sound and force of each character merely on seeing the animal from which it is derived, until such time as his imagination, strengthened by use and daily practice, leaves him with full and ready knowledge..."

Once familiarized with the alphabet, the child could then examine the illustrations above each chapter heading. The image would tell him what the title indicated. When he had scanned through the whole book, "he will automatically have learned to read from the mere titles of the pictures without having had to make use of a tedious and boring syllable presentation which is both mental torture and a strain for young minds." Thus Comenius, who was the father of education through pictures, was also the precursor of the global method of teaching reading.

It was also Comenius who first formulated the monitorial system of teaching, highly in vogue during the 19th century, and the idea of team-unit activity which stems from it. In *The Great Didactic* he advocated the division of classes into "groups of ten" each led by a monitor, with a head monitor in charge of several groups, "so as to stimulate attention and give all the pupils the benefit of what any one of their number says." Describing a written translation exercise (he pointed out that it could equally apply to other lessons) he wrote : "As soon as the leaders of divisions have secured attention, one scholar should be called upon to stand up and choose as his adversary any other scholar that he pleases." The pupil then reads out his exercise sentence by sentence while the entire class listens. "At the end of each sentence the scholar stops and his adversary has the opportunity of pointing out any mistake... Then other scholars in the division, and after them the whole class, may make criticisms on the rendering, and finally the teacher supplies any point that has been omitted... Then the adversary should read out his in the same way... Individual words and phrases are then criticized as before. After this, a second pair of adversaries is chosen and the same procedure is repeated for as long as time permits. Those who are still uncertain about a passage may bring forward their difficulties, or those who think that their rendering is better than that given may read it and receive criticism on it."

LEARNING BY SEEING. The use of visual aids in education for which Comenius was one of the pioneers, opened the road to the publication of many other illustrated textbooks. Above, illustration from a 19th century

In this way, collective teaching based on both emulation and the team spirit was substituted by Comenius for teaching imparted by the master to each pupil individually —a system which gave scamps left with nothing to do a magnificent opportunity to "raise the devil."

A whole study could still be written on all of Comenius' influences on modern teaching methods. One of his pleas, for example, was that classroom walls should be hung with pictures representing famous men and events of history, maps and other illustrations, as well as "models of all kinds to assist the memory to retain ideas and facts." The attractive appearance of the classroom, he said, "teaches the child, when he grows up, to beautify his home and make it more pleasant."

Comenius insisted that art education should be included in the curriculum. He protested (even at that time!) against over-work at school and held that children should not attend classes for more than four hours during the

mornings, leaving the afternoons free for singing, drawing and dancing.

In an age when education was limited to the privileged few and had neither a coherent body of doctrine nor firmly-established rules, Comenius conceived a systematic, comprehensive doctrine of school organization and laid the foundation for the modern ideals of universal, democratic education which is such an important part of UNESCO's world programme today. To Comenius must go the credit for writing the Charter of Free and Compulsory Education: "Not only are the children of the rich and the noble to be drawn into school, but alike gentle and simple, rich and poor, girls and boys, in great towns and small, down to the country villages. Everyone who is born a human creature should be educated." With his comprehensive ladder system of schools he saw a Mother School in every home, a Vernacular School in every hamlet and village, a Latin School in every city, and a University in every province. Centuries were to pass before these ideals were to be incorporated in the educational policies of nations.

Free schooling for all, an educational system based on the harmonious and progressive development of all the child's faculties up to the end of secondary education, vocational guidance, the application of activity and intuitive methods of teaching, the proper equipment of

UNESCO filmstrip, "Comenius"

Russian-German dictionary. The possibilities of wider applications of the three-centuries' old principles are now greater than ever before, thanks to the cinema, television, filmstrips and other modern inventions.

schools, teacher-training—such in brief are some of the major reforms which the Moravian philosopher set forth in *The Great Didactic* and which UNESCO has espoused.

Comenius, however, was not content just with the provision of educational opportunities for all. He believed that universal education must be informed with knowledge garnered from all the world, and that education must become a way of light so that "men's minds should be gradually raised from darkness to light and withdrawn from the vague and casual opinions to the one straightforward way of everlasting truth."

In his *Via Lucis* (Way of Light) written when in London in 1641, he recognized that his plans for the reform of education could not be carried out without newly organized collaboration on an international scale, including the foundation of a world academy. This led him to his plan for the *General Consultation on the Reform of Human Affairs*, the bulk of the manuscript of which was long thought to have been lost and was rediscovered only at the beginning of the Second World War by a Comenius scholar, D. Czyzevskij, at Halle, in Germany. *The Pampaedia* and *The Panorthosia* (a treatise on a Universal Improvement of Human Affairs) form the keystone of this huge unfinished work.

Comenius dreamt of closer links between all the countries of Europe and, once this union was solidly established, between all parts of the world. He did not underestimate the difficulties in the path of international collaboration, and preached tolerance and understanding to overcome them: "Let no one be blamed for the errors of the past... As in educating the young, what matters is to lead men from the known to the unknown; and 'to lead' like 'to educate' means to use peaceful means and never violent ones." He advocated therefore that men join together in the cause of peace, that they gather together in a great unified assembly of human solidarity, a community of minds and knowledge set up in a "Council of Light", an international organization where education, science and culture could be employed for the good of all mankind. Are these not the very principles, upon which UNESCO was founded?

The success of Comenius' works at the time of their publication was no doubt due in part to his skill in reworking and assimilating ideas which others had formulated before him. Comenius obviously knew of the educational doctrines propounded by Luther, Calvin and Melanchton who, while striving to reform the church had also proposed programmes of broad popular education. Nor was he ignorant of the reforms proposed by men such as Erasmus, Rabelais, Montaigne and even Milton. The revival of classical studies and discoveries in science had opened up new vistas for the human mind and created a new thirst for knowledge. There was a demand for new educational methods so that this vast, new body of knowledge might be included.

Genius synthesized a complex character

BUT historical perspective is not enough to explain the enduring interest of Comenius' work. Though the Czech educator owed much to pre-Renaissance and Renaissance thinkers such as Vives, Campanella, Alsted and particularly Bacon (from whom he derived his deep love of scientific progress, his ideas of collaboration between societies of learning, and his interest in the inductive method and its development) he also combined the abstract, deductive thinking of Central Europe with the more down-to-earth and individualistic philosophy of the English.

As Jean Piaget writes, "he was a theologian enamoured of metaphysics and imbued with the speculative spirit of the seventeenth century... This explains the twofold impression of outmoded form and up-to-date substance which one continually receives when reading the great educationist's works. In this respect, Comenius' metaphysics lies between scholasticism as inspired by Aristotle and the mechanicalism of the seventeenth century."

In a word, his character was highly complex. An ardent patriot, he dreamt of a peaceful federation of all nations. A methodical rationalist, he was imbued with the mystical theology of the Hussites. But these apparent contradictions in no way mar the deeper unity of his work, and are to be explained by his family background, his education and his life experience. Only a mighty genius could have merged them into a vast synthesis, the essential principles of which—at least as far as education and international affairs are concerned—have an amazing actuality. Leibnitz, Buisson and Raumer marvelled at his extreme breadth of mind; Michelet called him "the Galileo of Education"; and the American educator, Nicolas Murray Butler said of him that his relation to our present teaching is similar to that held by Copernicus and Newton toward modern science, and Bacon and Descartes toward modern philosophy.

Photos by Lotte Meitner-Graf, Maurice Dandelot Collection

THE MUSIC OF THE ORIENT IN REACH OF WESTERN EARS

by Yehudi Menuhin

One of Unesco's major undertakings is to encourage a better mutual understanding between Asian countries and those of the Occident through cultural exchanges. This is a question which concerns the International Music Council and also one of the world's great violinists, Yehudi Menuhin, who is President of the Asian Music Circle. While in Paris recently for a concert engagement, Yehudi Menuhin discussed these questions with representatives of Unesco and the International Music Council in an interview which has been broadcast in many parts of the world through Unesco's radio services. We reproduce below some of the points which were made by Yehudi Menuhin during this interview.

THE Asian Music Circle was organized some three years ago by a few Indian people, notably Mr. Angadi, in London, who knew of my trip to India and my great interest in Indian music and, of course, my interest in the music of the other countries of the East. They felt this great need of the people in London and the people in the West in general, to become acquainted with the music and the dance of the East and asked me if I would be President in New York of this organization and lend not only my name but also such good advice and help as I could to further this project. And the Asian Music Circle has been, I must say, eminently successful and proved to be an institution which responded to a general need.

I had not anticipated a response as great as it actually evoked, which proves that the people of England and the people of the West in general, as I had experienced in New York previously, are ready and eager for any opportunity to become acquainted with what is happening on the other side of the globe. I feel that the Asian Music Circle is a natural response to human curiosity — curiosity about people living beyond our reach, about the civilizations they have achieved, the ways of life, of music, of literature, of dance, they have developed on their own.

UNESCO has said there are no peoples "beyond our reach". That is theoretically true, but nonetheless, for the inhabitant of Paris or London or New York, Indian musicians (I mention India simply because I have had personal relations with India and its musicians whom I have helped to bring to New York) are normally beyond the reach of the ordinary person who is interested in music in New York or in any of the other large cities of the Western world. I have seen such wonderful response based largely on curiosity and the desire just to know what extraordinary shapes and forms sound has evolved in the course of thousands of years in the absence of our own scales and our own instruments and our own thoughts.

I am sure radio and film are important, and recordings as well, but primarily the initial impact should be, in my opinion, with the living person. In the experience of the Asian Music Circle those artists who have been brought over from the various Eastern countries have found understanding and response in England and, from my own personal experience, in New York as well.

I feel that music, too, offers almost the best means and road to the understanding of other people, precisely because one is not side-tracked by misleading words or symbols which have already acquired so many meanings. I have seen, for instance, the American audiences go mad with the rhythm of the Indian drummers — and that has done more to establish contact with India among those people who experience the performance than all the words that might be said or the books distributed which people might or might not read.

There is something compelling about the music — once the people are there they have to listen and if the personality of the performer is sufficiently strong and his dedication — as is the case with the great Indian musicians — is persuasive and compelling, the audience never fails to respond. The Asian Music Circle has achieved quite a considerable gain with each year over the preceding year in numbers of performances, numbers in attendance. The ambition now is to have permanent headquarters in London, because it is a function which is bound to continue and to increase regardless of who will take it over. It is a function which in the world we live in today is part of the very essence of the twentieth century — that we get to know each other.

'THE WORLD OF MUSIC'

The International Music Council has begun publication of a quarterly news bulletin, "The World of Music" for music lovers, professional musicians and the music trade. The first issue appeared in June 1957. (Subscription: 150 Fr. frs., 2/- stg.; $.50 per annum, from the International Music Council, 19, Avenue Kléber, Paris 16e.) Readers may also be interested in a record album sponsored by the International Music Council entitled "An Anthology of the Classical Music of India", comprising three long-playing records edited by Alain Daniélou and issued by Ducretet-Thomson, Paris. (Decca-London in the United Kingdom.)

UNESCO-Dominique Berretty

A SEARCH OF SCIENTISTS. Some 1,200 scientists from 61 countries took part in the Unesco International Conference on Radio-isotopes, at the Sorbonne in Paris. Rarely has a congress brought so many branches of science together. This was achieved because, as Sir John Cockcroft remarked in his presidential address (above), radio-isotopes have unique properties as research tools and are applicable to every branch of experimental science.

NEW TOOLS FOR SCIENTIFIC RESEARCH

Uses of radio-isotopes studied by Unesco International Congress

TWELVE hundred scientists from 61 countries and 25 international organizations met in Paris recently at a UNESCO International Conference on Radio-isotopes. For two weeks they discussed the uses that can be made of man-made atoms that can "rival atomic power in the benefits they confer on humanity."

Their discussions ranged over the entire face of nature, from the structure of the planets in space to mysteries of the living cell ; from weather-winds to unravelling the secrets of how plants capture the sunlight and use it to turn carbon-dioxide into our essential foods; from what happens in a blast furnace to the exclusive chemistry of antibiotics. This was science setting out on many new voyages to make many new discoveries. And its pilot for all of them was the radio-isotope.

It was appropriate that the conference was held in Paris, where Becquerel first discovered radio-activity, and Pierre and Marie Curie isolated radium, the natural radio-active element. The roll of participants was impressive. There was Frederic Joliot, who with his wife, the late Irene Curie, first produced an artificial radio-active element, and Sir John Cockcroft, President of the Conference, who with Walton first split the atom by man-made methods. There was F. Strassmann, who, with Otto Hahn, discovered uranium-fission, which made possible chain-reaction and the release of atomic energy. Four distinguished scientists were Conference vice-presidents: Willard F. Libby, member of the United States Atomic Energy Commission; Prof. Topchiev of the Academy of Sciences of the U.S.S.R.; Prof. Kenjiro Kimura of Japan and Prof. Louis Camille Bugnard of France. Besides these there were hundreds of others who are already famous or are making their names in the new fields of scientific endeavour that radio-isotopes are opening up.

Rarely does a scientific congress cover such a diversity of subjects or bring so many branches of science together. The reason was that they were discussing a laboratory tool, as common to all of them as the microscope has been in the past.

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This was highlighted by Sir John Cockcroft in his presidential address, when he said:

NEW TOOLS FOR RESEARCH *(Continued)*

"It is not often that a single tool or technique is the uniting factor to bring together scientists and specialists in such different fields... The radio-isotopes have achieved this because they have unique proporties as research tools and are applicable to every branch of experimental science. That UNESCO should undertake responsibility for organizing and presenting this conference is a tribute to the international importance of these new techniques."

The interpreters, simultaneously translating the proceedings in English, French, Spanish and Russian, were at the same time wrestling with a new language, the terms of which did not exist a few years ago, because a new dictionary was born when the atom was split and new words gain currency almost daily.

The terms were difficult and so were many of the subjects, but the principle of the radio-isotope techniques is not so difficult. As a result of atomic energy, there are available to research-workers man-made atoms which emit particles or rays which can be detected or measured by various devices. These are radio-active twins of all elements which exist in nature—such as gold, silver, iron, copper and carbon. Some isotopes radiate for only a split second; some like radio-aluminium for 800,000 years. The shortlived ones are too ephemeral to be of much practical use but, with fast aircraft today, useful versions of most elements can be delivered from the atomic reactors which produce them to laboratories all over the world.

From cat's whisker to transistor

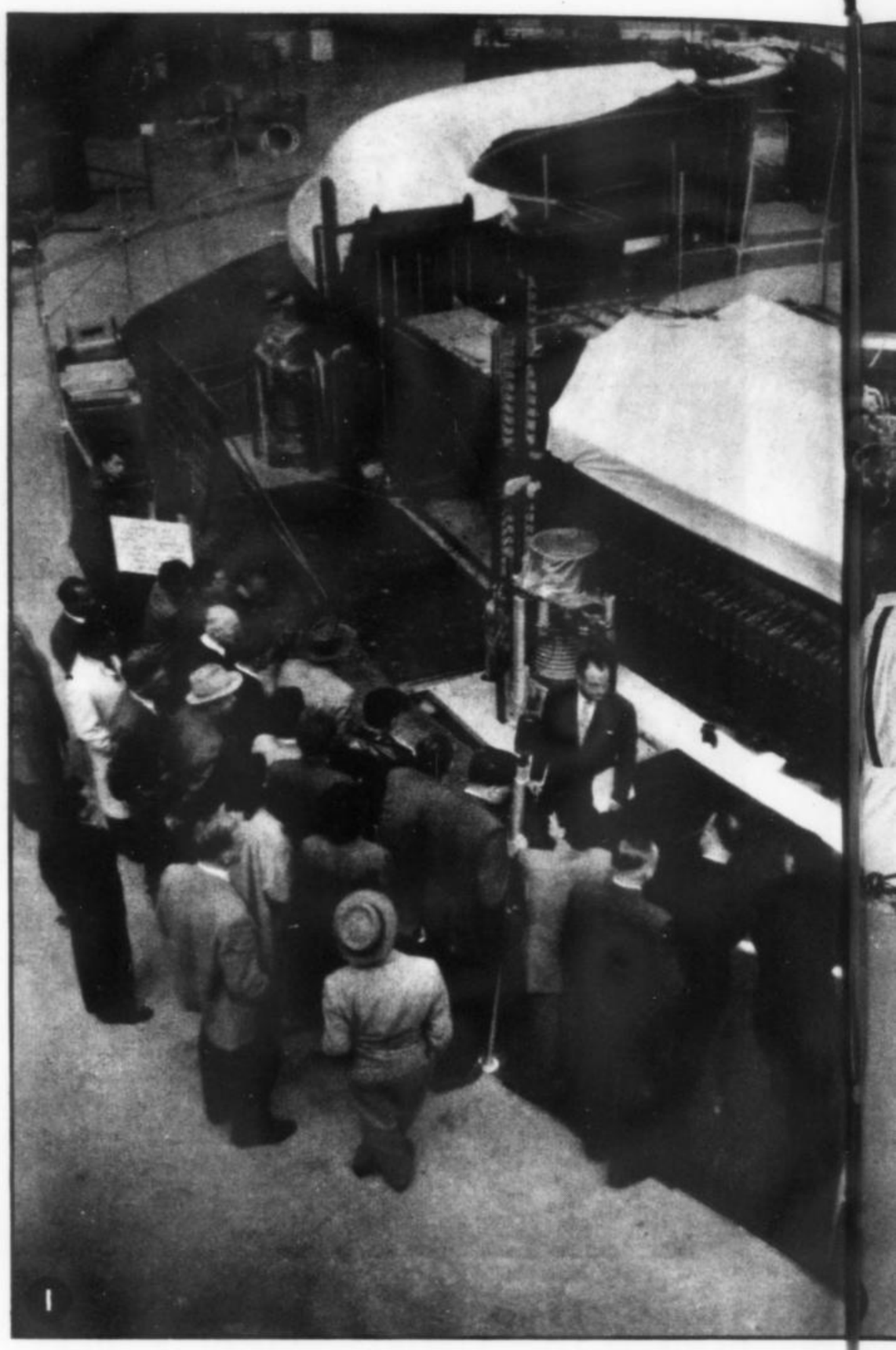
THESE man-made versions behave chemically exactly like their natural twins. They form alloys, combine in chemical compounds or take part in the living processes of plants, animals or humans. But, since they are labelled by their detectable rays, they can be followed through those processes so that scientists can discover exactly what happens in circumstances which nature has so far kept a close secret.

For example, science and industry have employed catalysts to speed up the combination of elements in chemical reactions. The catalyst is another chemical but does not itself combine. It is like a parson at a wedding, hastening the bonds of matrimony, but remaining a third party. But how? With radio-isotopes, as the conference was told, the mechanism is now being measured and defined.

Or consider the old "cat's whisker" crystal set which preceded the radio-tubes in the early days of broadcasting. A finger of wire would seek out some point in the crystal and, somehow, sounds would be snatched out of the ether. Today, the primitive crystal has evolved into the transistor, the midget valves of pocket radios. It is known that the "trick" is to have a crystal of pure germanium or silicon with an infinitesimal trace of impurity. In Paris, it was explained how radio-isotopes could "place" that impurity and measure the behaviour.

Again, consider the human brain and the processes which go on inside it. What is the chemistry of human thought and action? Again at this conference there were reports on the "labelling" of atoms which take part in those processes. It is possible to track alcohol or sleeping drugs into the brain and measure their action. That was only one aspect of the brain-chemistry mentioned by the researchers.

The living processes of the plants depend on sunlight, trapped by the green-pigmented chlorophyll cells and used to convert the carbon-dioxide of the air and the water and minerals of the soil into the food which animals and men eat. This is one of the most important lines of research because it is the basis of all survival. With radio-isotopes, the complicated and incredibly fast-moving processes of photosynthesis, this light-induced chemistry, are being "blue-printed". Chlorophyll (and what it means when a plant turns green and withers into yellow) is being studied. So is the carbohydrate cycle and how the plant turns carbon into sugars and starches. And how the chemicals are built up into amino-acids and protein.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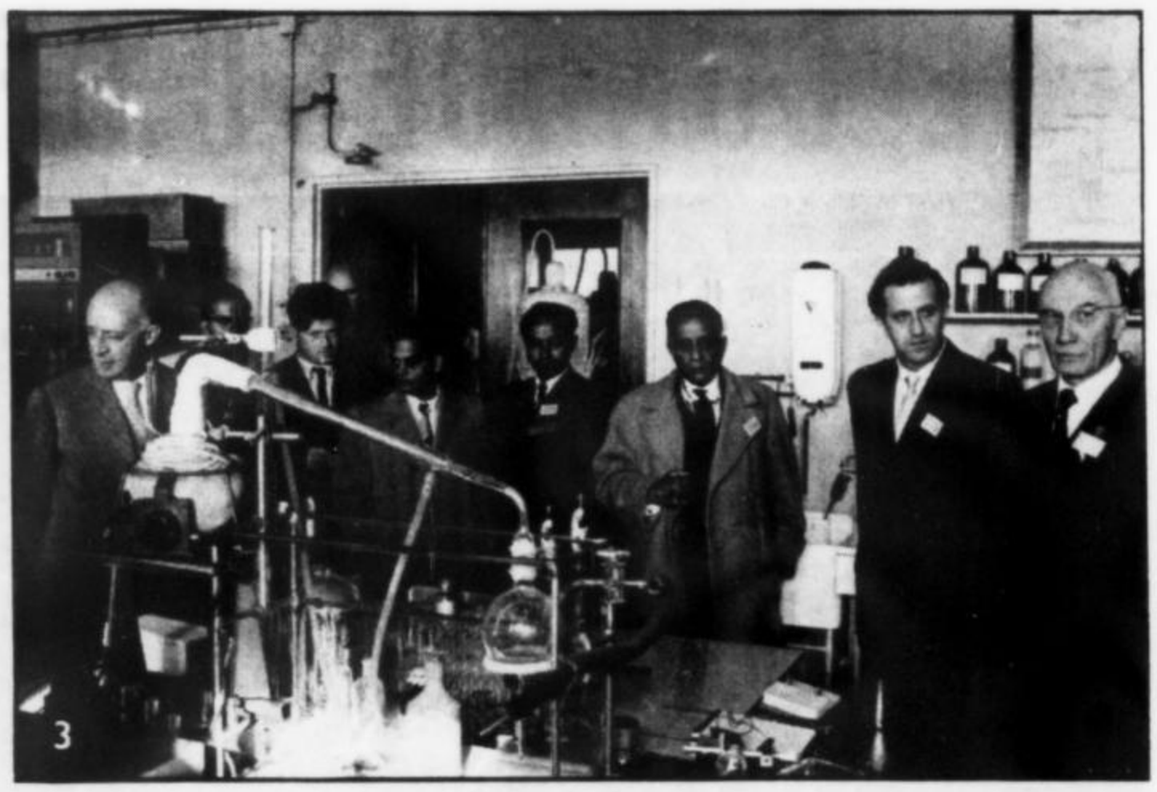
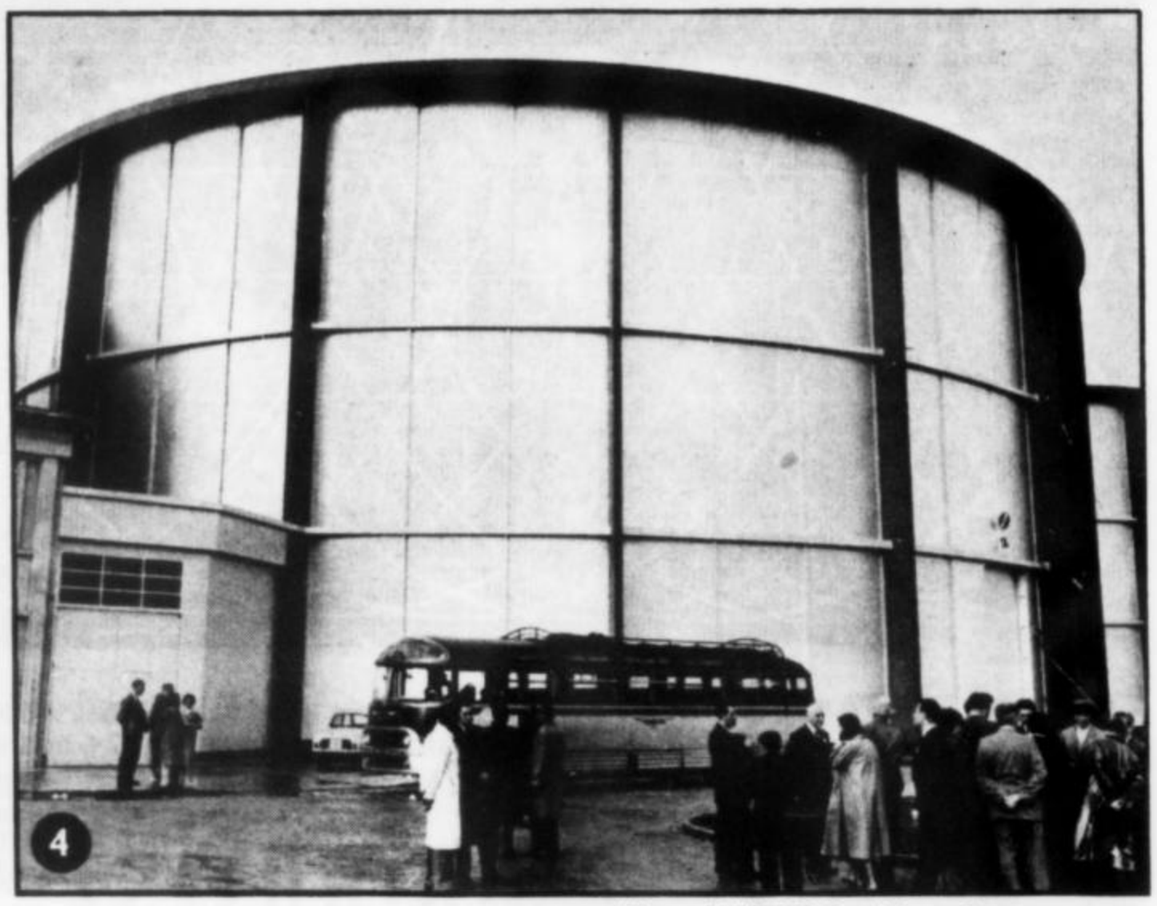
A VISIT TO 'SATURN' The major nuclear research centre of the French Atomic Energy Commission, located at Saclay, near Paris, was visited by scientists attending the Unesco International Conference on Radio-isotopes. Here they inspected "Saturn" (1) as the centre's giant proton-synchrotron is called. This powerful generator accelerates electrically-

Scientists have known about photosynthesis for 150 years but only now, with labelled atoms, are they learning how it works. The implications are profound because, in the long-run, engineers may take over from the radio-chemists and build factories to reproduce the processes of the living-plant, to make food from the elements as it does. Meantime, the knowledge will help plant-biologists to improve the efficiency of plants.

Plants also need minerals from water and soil. Great interest centred on the discussions at the conference on how the chemicals were transferred through the roots to the stems and leaves of flowers. By adding labelled atoms to fertilisers, scientists can detect the amounts, and movements, of minerals in plants. The findings are of great importance to agriculture. For example, it was shown that in cold soils, essential chemicals were not absorbed by the roots sufficiently, but if fertilisers were applied to the leaves, they would nourish the plants. This can mean much in the cold regions where crops have been restricted





Photos UNESCO-Dominique Berretty

rged particles which are then directed at a target formed by atoms ng examined. The disintegration of the atomic nucleus under the pact of the particles enables physicists to study its structure and the ure of the forces existing within the nucleus. Scientists also inspected and 3) two of the research laboratories. In laboratory (2) visitors are plied with overalls and protective coverings for their shoes. Circular building (4) houses a nuclear reactor. The reactors or piles at Saclay are used for many kinds of experiments classed in two major groups — those relating to the constructional features of the piles themselves (cooling system, arrangement of the uranium bars, etc,) and those to determine the effects of radiations given off by the piles (the behaviour of the structural materials and the reaction of living organisms, for example).

soil-temperatures. It was also shown that contrary to the evious belief that the sap-circulation of the plant moved by sorption from the soil and transpiration through the leaves, thout anything equivalent to the heart-pump in the animals humans, there is, in fact some energetic "pumping" system, ll undefined.

toms in overalls' save $406 million yearly

TUDIES of meteorites, by radio-active tracers, are revealing new information about the shattered planet from which they came. The movement of tritium—radio-active hydrogen—in e weather system is teaching how the air-currents move and ingle and how the moisture evaporated from the sea is deposit- as rain on the land—or how much comes from inland waters. he bottoms of the oceans are being examined. Scientists are assessing the age of rocks and re-dating the world. With dio-active carbon measurements they provide a calendar for e relics of past civilizations.

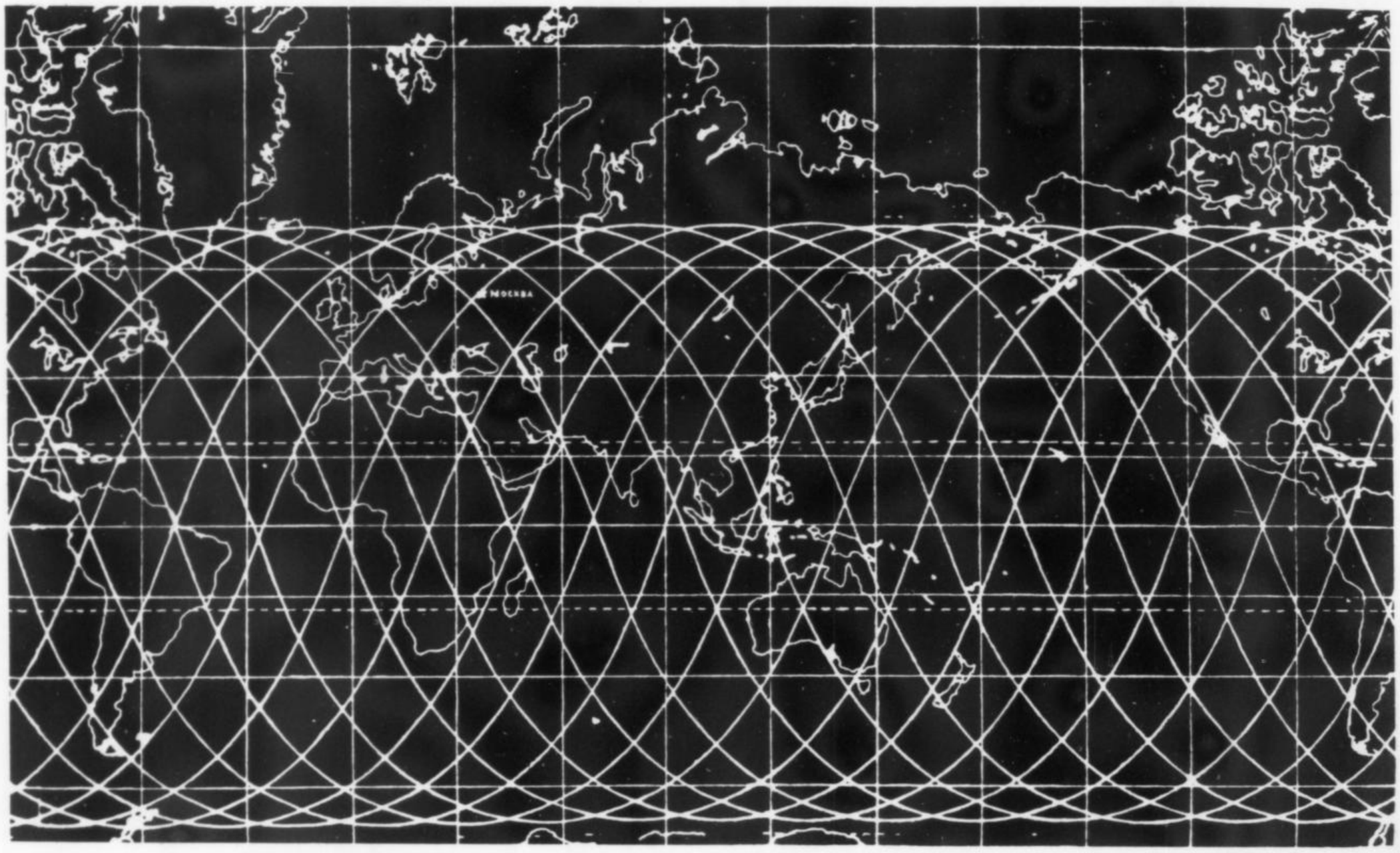
So through forty sessions, scientists compared notes. In the rridors, they "did each other's homework" because, as Professor Bugnard pointed out, the human contacts were as important as the papers or formal discussions. Scientists formed new friendships and obtained "new tips".

After the scientific sessions, public lectures were delivered each evening by the leading authorities attending. In those, the practical applications of radio-isotopes were illustrated.

There are thousands of ways in which those man-made atoms are being supplied to industry, agriculture and medicine. Dr. Willard F. Libby reported that a careful review in November 1956 showed that the savings produced in American industry by isotopes amounted probably to $ 390 millions a year. By July 1957 it was $ 406,000,000 and by 1962 it will be more than ten times as much—$ 5,000,000,000 a year.

All this is a by-product of atomic energy. Sir John Cockcroft suggested that radio-isotopes would rival atomic power in the benefits they confer on humanity. These are "the peaceful uses of atomic energy" which many fear is fraught with hazard. But Dr. W.G. Marley, the leading British authority on health physics, said that after a careful review of all the risks and precautions, the use of radio-isotopes in scientific research, in medicine and in all branches of industrial technology can be greatly expanded without risk to the public health.

THE CONQUEST OF OUTER SPACE



Official Soviet photos

GIRDLING THE EARTH at a speed of 8,000 metres a second (about 18,000 m.p.h.), "Sputnik" makes a complete orbit in one hour 36 minutes. Diagram shows the path of the satellite on each of its trips during 24 hours. The satellite's orbit is 65° away from the plane of equator.

❶ A Soviet Scientist looks at 'Sputnik'

by K. Staniukovich

Member of the Interplanetary Communications Commission of the Academy of Sciences of the Soviet Union

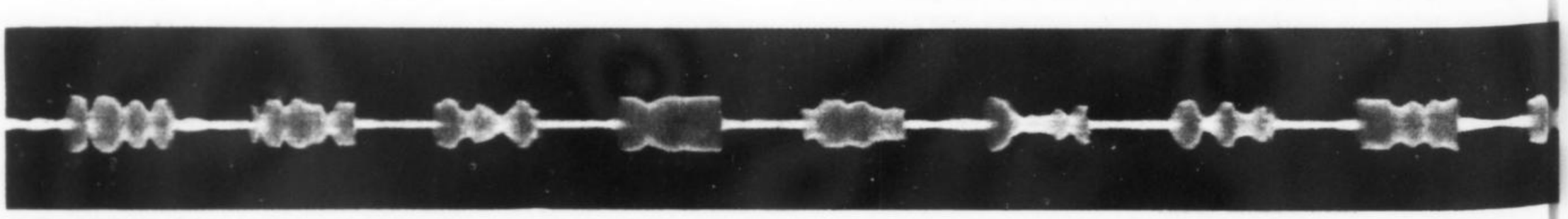
October 4, 1957, can be considered as the date marking the beginning of the era of man's conquest of cosmic space. A scientific problem of foremost importance has now been solved but its full import is not easy to grasp in our time.

The launching of the artificial satellite demonstrates the progress that has been made in a number of sciences and technical domains. This has resulted in the achievement of what only recently was considered to be an unrealizable dream. The mere perfection of rocket techniques, however, would not have been enough to launch artificial satellites with certainty into the upper layers of the atmosphere. For that, additional factors were needed: the development of the construction of instruments, the creation of electronic calculating machines capable of determining the most advantageous trajectory of the satellite and a high standard of science and modern techniques generally.

The event of October 4, 1957, is important for several reasons: first, proof has now been furnished of the possibility of launching a satellite into a relatively stable orbit; second, men the world over can proudly observe that an object now exists whose movements do not seem to be governed by the force of gravity—in the sense that this body will not fall to earth for a very long period and that its fall will occur only as result of resistance to the medium in which it is moving.

As early observations have shown, the "Sputnik's" period of rotation around the earth has been reduced by several seconds in several days. This observation alone makes it possible to draw many conclusions of the utmost importance to geophysics. The density of the air at an altitude of 500 or 550 miles (the height of the satellite at its furthest distance from the earth) is so small that it evidently does not exceed 10 to 18 grammes per cubic centimetre.

In this region air molecules must travel enormous distances of several thousands of

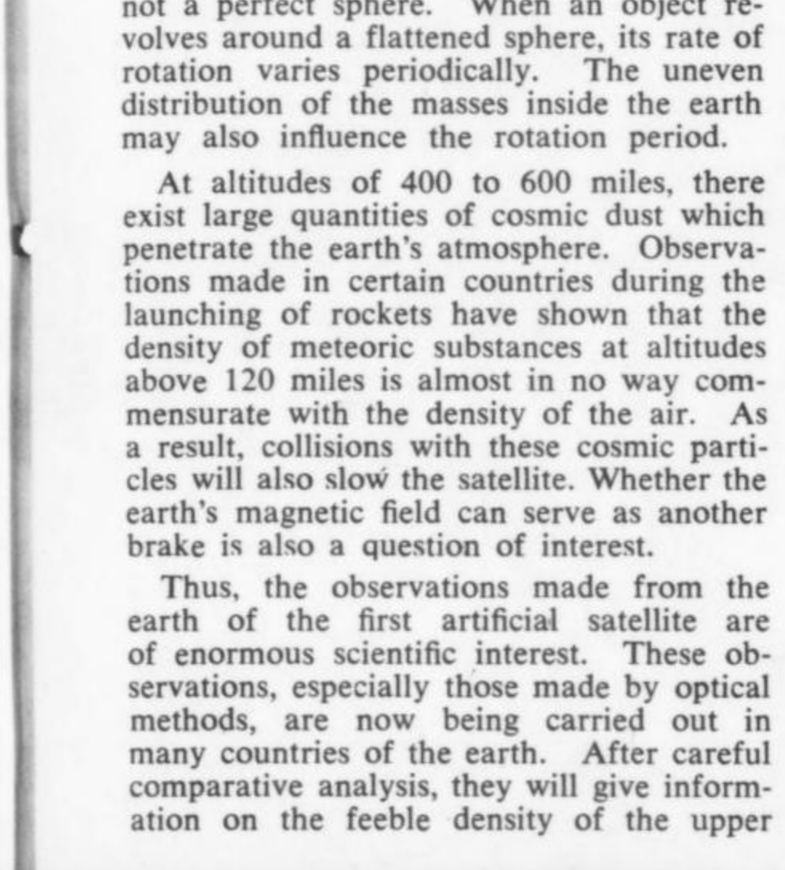


BEEP-BEEP-BEEP of Soviet satellite's radio transmitter signals, varying in length, frequency and spacing, have been picked up by receivers around the world. Here is an Oscilloscope trace of "Sputnik's" beeps. Future Soviet satellites will radio reports on meteoric activity.

miles before colliding. As the orbit of the satellite is in the form of an ellipse, it passes through more dense layers of the atmosphere at its closest point to the earth. It is here, where the density of the air is greater, that the slowing down of the satellite is chiefly taking place. There may however, be other causes for a change in the rotation period of the satellite. One of these may be the fact that our planet is not a perfect sphere. When an object revolves around a flattened sphere, its rate of rotation varies periodically. The uneven distribution of the masses inside the earth may also influence the rotation period.

At altitudes of 400 to 600 miles, there exist large quantities of cosmic dust which penetrate the earth's atmosphere. Observations made in certain countries during the launching of rockets have shown that the density of meteoric substances at altitudes above 120 miles is almost in no way commensurate with the density of the air. As a result, collisions with these cosmic particles will also slow the satellite. Whether the earth's magnetic field can serve as another brake is also a question of interest.

Thus, the observations made from the earth of the first artificial satellite are of enormous scientific interest. These observations, especially those made by optical methods, are now being carried out in many countries of the earth. After careful comparative analysis, they will give information on the feeble density of the upper



SPUTNIK photographed before take-off. Facts about it have been given as follows: diameter, 22.8 in.; weight, 184.3 lbs. A sphere made of aluminium alloys, it has four metal rods as antennae, and these are 7.9 to 9.5 ft. long.

layers of the atmosphere including the cosmic fields, and will also make it possible to reach scientific conclusions on the form and structure of the earth's inner layers.

It seems to me that one of the most important tasks of astronautics is to undertake a more precise study of the quantity of minute meteors and of the number of meteors of larger dimensions cruising through space. Of great importance, too, is the study of the speeds at which these meteors may collide with the body of a rocket. When a meteor strikes the body of a rocket or any other object at a speed exceeding one kilometre (.621 of a mile) per second, a sharp explosion occurs. The mass of the rocket is greater than that of the meteor. At a collision speed of 30 kilometres a second, calculations have shown that the mass of the materials in the body of the rocket is several thousand times greater than that of the meteor.

Even the impact of a meteor weighing only a few milligrammes can therefore be dangerous for an artificial satellite. True, the probability of meeting such a meteor is small but over a period of weeks or months an encounter may nevertheless occur. By studying the information obtained as a result of the launching of "Sputnik" and by determining the true danger of these collisions, it will be possible to discover means of coping with them, such as the construction of two or more protective sheaths for either artificial satellite or rocket.

The quantity of meteoric dust showering down on to the earth varies according to the seasons. There are periods when meteoric activity is at a maximum and periods when it is almost completely absent. In order to observe meteorites and their collisions, satellites in the near future will be equipped with apparatus to report on such phenomena by radio.

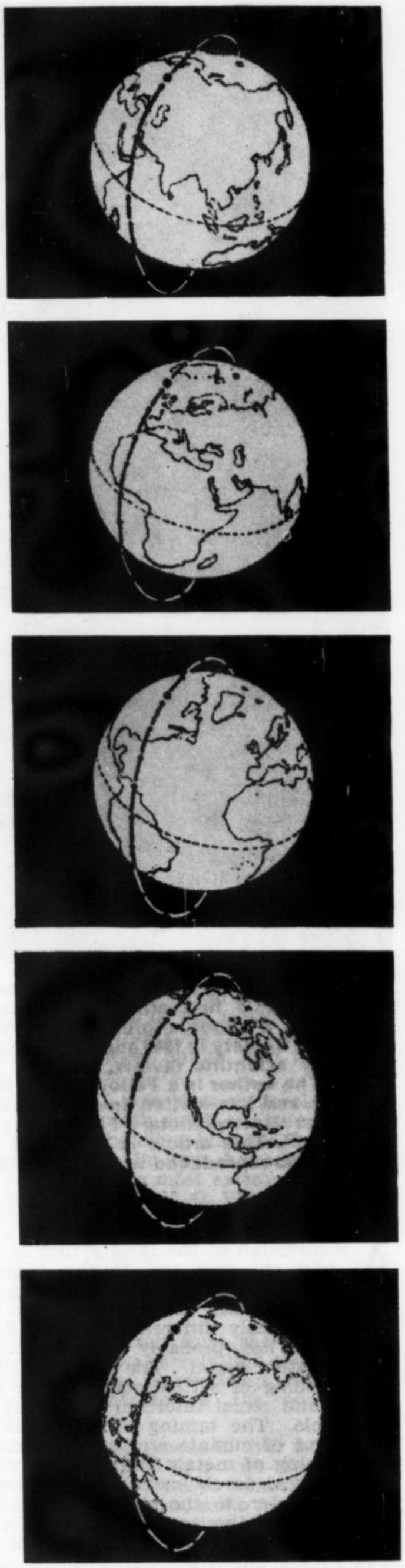
Another very important task is the study of the earth's electro-magnetic fields, the ionization of the upper layers of the atmosphere, cosmic rays and cosmic radiation. Animals, sent aloft equipped with transmitters, will furnish information on how creatures are affected by space flight. Thus, for example, it will be possible to study the influence upon them of cosmic rays coming from the sun and not absorbed by the earth's atmosphere, or the behaviour of animals in the absence of gravity.

Finish in flame & dust

THERE is a great deal of interest in what will become of the artificial satellite "Sputnik" and of the final-stage launching rocket which now accompanies it. It is possible that within a few weeks the satellite will penetrate the lower layers of the atmosphere and will be increasingly braked by the air's slowing friction. At this point, the speed at which it approaches the earth will increase. At an altitude of about sixty miles, its speed will be such that its aluminium body will disintegrate in a burst of flames and drop into atmospheric layers in the form of fine dust. The launching rocket, as its movements observed in the skies show, has for some time now outdistanced the satellite.

Astrophysicists are interested in many complex problems, in particular those connected with the study of the sun. Like all men on earth, astrophysicists who study the planets are interested in learning whether oxygen exists on Mars. Observations made on earth have been unable as yet to detect an oxygen spectrograph line on the planet Mars, but it is possible that a very weak line may be absorbed by the earth's own atmosphere, for there is probably less air on Mars than on Earth. It remains to be seen what the spectrographic observations of the satellite will tell us.

In a few years, the orbits of the earth's artificial satellites will approach the moon. The artificial satellite which will fly to the moon will be equipped with special apparatus. This will be the stepping stone for man's future voyages into outer space. We are convinced that the launching of artificial earth satellites, equipped with non-military instruments will enable scientists to serve the cause of peace.



SATELLITE'S ORBIT brings it over a different part of the globe (due to earth's rotation) on each of its completed circles. Its orbit is so steady and it has lost so little speed that its path in relation to the earth can easily be computed in advance. These five diagrams show different orbits, the first being the one taking the "man-made moon" over Moscow.

2

THE CHALLENGE OF THE SPACESHIP

by Arthur Clark

This timely article was written long before the launching of the world's first artificial satellite. It is a revised version of a paper originally read to the British Interplanetary Society in 1946 and published in 1953 in UNESCO'S quarterly scientific review, "Impact of Science on Society. The author is a Fellow of the Royal Astronomical Society, and has written several books on the subject, in particular "Interplanetary Flight" and "The Exploration of Space". This article is copyright by the author and may not be reproduced without permission.

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An historian of the twenty-first century, looking back past our own age to the beginnings of human civilization, will be conscious of four great turning points which mark the end of one era and the dawn of a new and totally different mode of life. Two of these events are lost, probably forever, in the primeval night before history began. The invention of agriculture led to the founding of settled communities and gave man the leisure and social intercourse without which progress is impossible. The taming of fire made him virtually independent of climate and, most important of all, led to the working of metals and so set him upon the road of technological development—that road which was to lead, centuries later, to the steam engine, the Industrial Revolution, and the age of steel and petrol and surface transportation through which we are now passing.

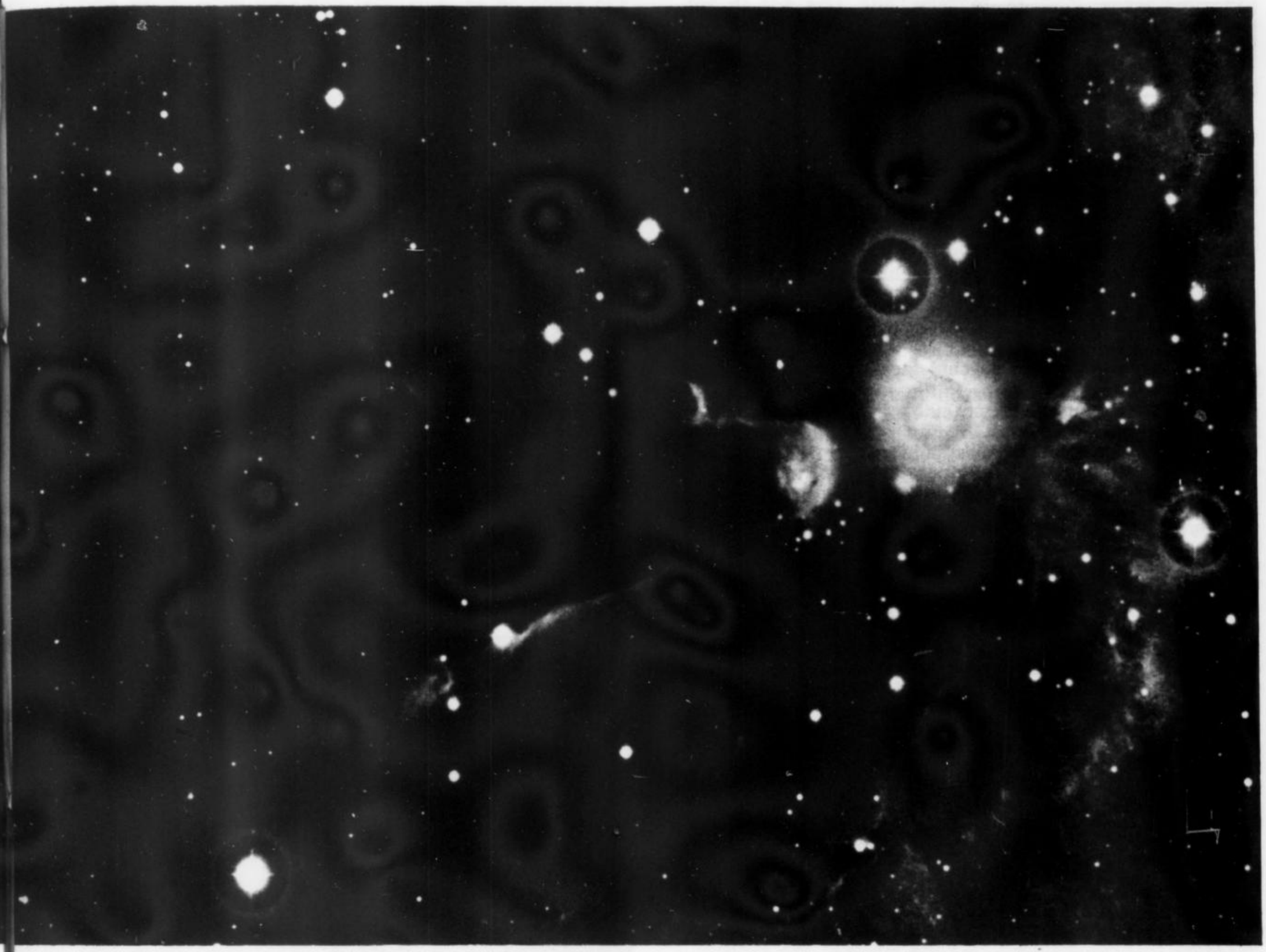
The third revolution began, as all the world knows, in a squash-court in Chicago on December 2, 1942, when the first self-sustaining nuclear reaction was started by man. We are still too close to that cataclysmic event to see it in its true perspective, but we know that it will change our world, for better or for worse, almost beyond recognition. And we know too that it is linked with the fourth and in some ways greatest change of all—the crossing of space and the exploration of the other planets.

The first spaceships capable of reaching another world may still lie half a century ahead, but the giant rocket is already with us and will soon be carrying men to the limits of the atmosphere and beyond. Nor will it be many years before a guided missile reaches the moon and blazes the trail along which men will travel a generation later.

An attempt to construct a philosophy of astronautics is therefore far from premature: it is, if anything, a little belated. In the last few years we have seen the political and ethical chaos produced when a great technical development comes into a world which is unprepared for it.

If our civilization is to have a future, then we must see that it does not repeat its earlier mistakes. I do not suggest—as some have done—that lawyers need start worrying immediately about the ownership of the moon, but the ownership of space will soon be a matter of acute practical importance. If country A fires experimental rockets across its neighbour B, what does B do? The air above B is admittedly its own property, but how far does that jurisdiction extend? There will have to be some equivalent of the three-mile limit; otherwise in the course of a day every country will, by virtue of the earth's rotation, lay claim to a large portion of the universe! This problem will be of grave concern in another decade, when long-range research projectiles begin to travel far outside the atmosphere with a supreme indifference to the geography beneath them.

The ideals of astronautics are new, but the motives and impulses underlying them are as old as the human race. There was a time—not long ago—when those who advocated interplanetary travel were always being asked. "How?" Even before the war that question could be answered in general terms, but there had been no large-scale engineering achievement to support the claims put forward. It is amusing to recall that in those days—which now seem so remote—there were many people who refused to believe that a rocket could work in a vacuum or would ever be able to rise more than a few miles from the earth.



Today, the power of the rocket has been demonstrated, only too thoroughly. "How" is a question one seldom hears in discussions concerning space-flight: the commoner query is now "Why?" And it is much more difficult to answer, for it involves the motives underlying all human conduct.

The urge to explore, to discover, to "follow knowledge like a sinking star," is a primary human impulse which needs, and can receive, no further justification than its own existence. The search for knowledge, said a modern Chinese philosopher, is a form of play. If this be true, then the spaceship, when it comes, will be the ultimate toy that may lead mankind from its cloistered nursery out into the playground of the stars.

When the oceans begin to boil

HOWEVER, it is not hard to think of entirely valid "practical" reasons why one should wish to cross space, and some of these we will discuss later. There is no doubt that eventually sheer necessity would bring about the conquest of the other planets. I do not believe that it is possible to have a virile, steadily-advancing culture limited to a single world, and taking the long-term view, we know that our earth will one day become uninhabitable.

In his book, *The Birth and Death of the Sun* (1), the physicist George Gamow points out that before its evolution has finished, our sun will become 100 times as luminous as it is today. I am glad to see that he draws the obvious conclusion and visualizes the migration of humanity to the outer planets before our earth's oceans have begun to boil.

But the human race will not wait until it is kicked out. Long before the sun's radiation has shown any measurable increase, man will have explored all the solar system and, like a cautious bather testing the temperature of the sea, will be making breathless little forays into the abyss which separates him from the stars.

To support my argument, I now have to develop some sort of time-scale. I do this with much reluctance, since prophecy is a dangerous and thankless business, frequently fatal to those who practise it. We have, however, learned by past experience that even the most extravagant forecast seldom overtakes the truth. H. G. Wells once wrote —and was no doubt laughed to scorn for his folly—that the aeroplane might have some influence upon warfare by 1950. Even Wells never imagined that by that date aircraft would not only have become of supreme importance but would have been challenged by still newer weapons.

The advances in rocket research since the 1940's have been phenomenal, but they have merely laid the foundations for what is still to come. Nevertheless, it is worth recording present achievements to fix the position of astronautics as it is today.

Heights of 385 kilometres and speeds of over 8,000 kilometres an hour have been attained by a "two-step" rocket fired from White Sands, main centre of American rocket activity. A large number of missiles, some more efficient and with higher ceilings than the original German V.2, have been developed. (For example the Viking, which though a single-stage rocket, should ultimately have a ceiling of over 300 kilometres)

A great deal has been learned about the upper atmosphere by means of instruments carried in such rockets, which send their readings by radio to ground stations. In this way physical recovery of the rocket is unnecessary—though recently this has been achieved by means of special parachutes.

Cont'd on next page

(1) *Viking Press, New York, 1940, and MacMillan, London, 1941.*

CHALLENGE OF THE SPACESHIP
(Continued)

Lunar round-trips by atomic rockets

In addition, manned rocket vehicles, such as the Douglas Skyrocket—known to have flown at well over 2,000 kilometres an hour—have also been developed. These machines can hardly be called aircraft, since they operate at altitudes so great that conditions around them are almost the same as in (airless) space.

During the next decade, the techniques necessary to send small, radio-controlled rockets to the moon will become available. Such rockets would weigh about 50 tons at take-off and have a payload of a few kilogrammes. They could make astronomical reconnaissance flights of great scientific—and also psychological—importance.

There is no reason why such flights should not take place by 1960. The public, not realizing the problems still to be faced, will expect human beings to follow in a very short time. It will be disappointed. During the subsequent years there will be innumerable short-range flights beyond the atmosphere by man-carrying ships reaching heights of a few thousand kilometres—and, as I have mentioned earlier, raising all sorts of petty legal problems. But if we have to rely on chemical fuels, it may require at least 20 years of further experimenting before the first true spaceship lands on the moon and returns to earth.

That brings us to the late 1970's. Any chemically-fuelled spaceships will be unwieldy, fabulously expensive machines with fuel consumptions measured by the thousand tons for a single voyage. Not more than one or two countries will be able to build them, and they will be of scientific value only. There will be no question, for a very long time, of colonization or of voyages to the other planets. But—and it is a very large but—any prophet would indeed be rash if he based his predictions upon the use of chemical fuels alone.

Coasting flights halfway round the sun

HERE, as in other fields, the great question-mark is atomic energy. In theory, a few kilogrammes of uranium could take a ship weighing 1,000 tons to the moon and back. In practice, we have a very long way to go before this can be done. At the moment one possible solution is that some form of enriched, high-temperature pile or reactor could be developed to accelerate a "working fluid" such as hydrogen, helium or some other gas of low molecular weight and so give a propulsive jet. Very great engineering difficulties will have to be overcome before this can be done, and an alternative solution is to use what has been called the "ion rocket." In this device charged particles would be accelerated by electric fields to produce the jet—the necessary fields being generated by nuclear energy. Such a scheme would have many advantages, but it could only operate in airless space—and it could only produce such low thrusts that it could not possibly lift a spaceship up from the earth's surface against the direct pull of gravity.

This is by no means a fundamental disadvantage, and indeed fits in very well with current ideas on astronautics. The fact that it is not possible for any spaceship to carry enough fuel for a voyage to another planet *and back* has long focused attention on what have been called "orbital techniques." Once a rocket is above the atmosphere and therefore no longer subject to air resistance, it becomes theoretically possible for it to turn itself into a sort of "artificial moon." All it need do to achieve this is to reach the necessary speed in horizontal flight, and from there on it will stay in its orbit without using any more power—just as the moon itself does. It could wait effortlessly until "tanker" rockets were sent up to refuel it: then, when its supplies had been replenished, it could continue on its way.

In this manner any interplanetary journey can be broken down into a number of stages, with refuelling between them, and this procedure is believed to be the key to space-flight. It seems likely that we may use the present-day "chemical" rockets to climb up from earth into the refuelling orbit, and then continue from there using atomic or "ion" rockets.

Atomic power is hardly likely to advance the conquest of space by more than 10 years, but it may make it practical almost from the beginning, which otherwise would certainly not have been the case. What is equally important, it will mean that the whole solar system, and not merely the moon, will be immediately accessible to man. It requires little more power to reach the planets than it does to go to the moon, but the most economical voyages involve months or even years of free "coasting" along orbits curving halfway round the sun. With atomic power these journeys could be cut to a fraction of the time. For example, the "cheapest" journey to Mars—as far as fuel is concerned—lasts 258 days. With an atomic ship, travelling by a more direct route at quite a moderate speed, it need take only a few weeks.

The last quarter of this century will be an age of exploration such as man has never before known. By the year 2,000 most of the major bodies in the solar system will probably have been reached, but it will take centuries to examine them all in any detail. Those who seem to think that the moon is the goal of interplanetary travel should remember that the solar system contains eight other planets, at least 30 moons, and some thousands of asteroids. The total area of the major bodies is about 250 times that of earth, though the four giant planets probably do not possess stable surfaces on which landings could be made. Nevertheless, that still leaves an area 10 times as great as all the land surface of the earth.

This, then, is the future which lies before us, if our civilization survives the diseases of its childhood. It is a

USIS

DESTINATION MOON. An imaginary rocket has landed on the moon and is about to take off for an interplanetary voyage. This photo taken from a recent American film, "Destination Moon", produced with the help of Mount Palomar Observatory in California. Destination moon may soon no longer be limited to science fiction tales.

future which some may find terrifying, as no doubt our ancestors found the hostile emptiness of the great oceans. But the men who built our world crossed those oceans and overcame those fears. If we fail before the same test, our race will have begun its slide into decadence. Remember, too, that when the great explorers of the past set sail into the unknown they said goodbye for years to their homes and everything they knew. Our children will face no such loneliness. When they are among the outermost planets, when the earth is lost in the glare of the sun and the sun itself is no more than the brightest of the stars, they will still be able to hear its voice and to send their own words in a few hours back to the world of men.

Let us now consider the effects which interplanetary travel must have upon human institutions and ideas. The most obvious and direct result of the crossing of space will be a revolution in almost all branches of science. I shall not attempt to list more than a few of the discoveries we may make when we can set up research stations and observatories upon the other planets. One can never predict the outcome of any scientific investigation, and the greatest discoveries—the ones which will most influence human life—may come from sciences as yet unborn.

TV relay stations circling the earth

ASTRONOMY and physics will, of course, be the fields of knowledge most immediately affected. In both these sciences there are whole areas where research has come to a dead end, or has never even started, because our terrestrial environment makes it impossible.

The atmosphere, which on a clear night looks so transparent, is in reality a coloured filter blocking all rays beyond the ultra-violet. Even in the visible spectrum the light that finally struggles through the shifting strata above our heads is so distorted that the images it carries dance and tremble in the field of the telescope.

An observatory on the moon, working with quite small instruments, would be many times as effective as one on earth. Far greater magnifications could be employed, and far longer exposures used. In addition, the low gravity would make relatively simple the building of larger telescopes than have ever been constructed on this planet.

In physics and chemistry, access to vacua of unlimited extent will open up quite new fields of investigation. The electronic scientist may well look forward to the day when he can build radio tubes a kilometre long, if he wishes, merely by setting up his electrodes in the open! We may learn more about gravity when we can escape partially or wholly from its influence.

The prospect of building stations in space, circling the earth like tiny moons in orbits beyond the atmosphere, is one that has a peculiar fascination. Such stations were first proposed by the Germans as refuelling depots for spaceships, but even if that need never arises they would have other most important applications. Meteorological observatories in space could see at a glance the weather over half the planet, could watch in detail the movement of storms and rain areas. The wonderful photographs of the earth from V.2 rockets give a hint of what may be done in this direction. Indeed, really accurate forecasting may have to wait until meteorologists get out into space.

The space station has one other application of the greatest importance, for it provides perhaps the only means of worldwide television broadcasting. As is well known, the reliable range of a television transmitter extends barely beyond the horizon. A dozen stations at least would be needed to cover completely a country as small as Great Britain, and continental or world services would be completely out of the question. Yet three relay stations circling the earth could provide a steady, reliable service from pole to pole with no more power output than a single present-day station.

However, the first direct results of astronautics may be less important than its indirect consequences. This has proved true in the past of many great scientific achievements. Copernican astronomy, Darwin's theory of evolution, Freudian psychology—these had few immediate practical results, but their effect on human thought was tremendous.

We may expect the same of astronautics. With the expansion of the world's mental horizons may come one of the greatest outbursts of creative activity ever known. The parallel with the Renaissance, with its great flowering of the arts and sciences, is very suggestive. "In human records," wrote the anthropologist J.D. Unwin, "there is no trace of any display of productive energy which has not been preceded by a display of expansive energy. Although the two kinds of energy must be carefully distinguished, in the past they have been . . . united in the sense that one has developed out of the other." Unwin continues with this quotation from Sir James Frazer: "Intellectual progress, which reveals itself in the growth of art and science . . . receives an immense impetus from conquest and empire." Interplanetary travel is now the only form of "conquest and empire" compatible with civilization. Without it, the human mind, compelled to circle forever in its planetary goldfish bowl, must eventually stagnate.

We all know the narrow, limited type of mind which is interested in nothing beyond its town or village, and bases its judgments on parochial standards. We are slowly—perhaps too slowly—evolving from that mentality towards a world outlook. Few things will do more to accelerate that evolution than the conquest of space. It is not easy to see how the more extreme forms of nationalism can long survive once men see the earth in its true perspective as a single small globe among the stars.

The solar system is rather a large place, though whether it will be large enough for so quarrelsome an animal as *Homo sapiens* remains to be seen. But it is surely reasonable to hope that the crossing of space will have a considerable effect in reducing the psychological pressures and tensions of our present world. Much depends, of course, on the habitability of the other planets. It is not likely that very large populations will, at least for many centuries, be able to subsist outside the earth. There may be no worlds in the solar system upon which men can live without mechanical aids, and some of the greatest achievements of future engineering will be concerned with shaping hostile environments to human needs.

We must not, however, commit the too common mistake of equating mere physical expansion, or even increasing scientific knowledge, with "progress"—however that may be defined. Only little minds are impressed by sheer size and number. There would be no virtue in possessing the universe if it brought neither wisdom nor happiness. Yet possess it we must, at least in spirit, if we are ever to answer the questions that men have asked in vain since history began.

Every thoughtful man has asked himself: is our race the only intelligence in the universe, or are there other, perhaps far higher, forms of life elsewhere? There can be few questions more important than this, for on its outcome may depend all philosophy—yes, and all religion too.

Is ours the only abode of life in space?

THE first discovery of planets revolving round other suns, which was made in the United States in 1942, has changed all ideas of the plurality of worlds. Planets are far commoner than we had believed: there may be thousands of millions in this galaxy alone. Few men today would care to argue that the earth must be the only abode of life in the whole of space.

It is true—it is even likely—that we may encounter no other intelligence in the solar system. That contact may have to wait for the day, perhaps ages hence, when we can reach the stars. But sooner or later it must come.

There have been many portrayals in literature of these fateful meetings. Most science-fiction writers, with characteristic lack of imagination, have used them as an excuse for stories of conflict and violence indistinguishable from those which stain the pages of our own history. Such an attitude shows a complete misunderstanding of the factors involved.

Remember the penny and the postage stamp which Sir James Jeans in the *Mysterious Universe* (1) balanced on Cleopatra's needle. The obelisk represented the age of the world, the penny the whole duration of man's existence, and the stamp the length of time in which he has been slightly civilized. The period during which life will be possible on earth corresponds to a further column of stamps hundreds of metres—perhaps a kilometre—in height.

Thinking of this picture, we see how

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(1) *Cambridge University Press, and MacMillan., New York,* 1930.

CHALLENGE OF THE SPACESHIP
(Continued)

We may meet superhuman races

infinitely improbable it is that the question of interplanetary warfare can ever arise. Any races we encounter will almost certainly be superhuman or subhuman—more likely the former, since ours must surely be one of the youngest cultures in the universe. Only if we score a bull's eye on that one stamp in the kilometre-high column will we meet a race at a level of technical development sufficiently near our own for warfare to be possible. If ships from the earth ever set out to conquer other worlds they may find themselves, as they arrive, in the position of painted war-canoes drawing slowly into New York Harbour.

But if the universe does hold species so greatly in advance of our own, then why have they never visited the earth? There is one very simple answer to this question. Let us suppose that such races exist: let us even suppose that, never having heard of Einstein, they can pass from end to end of the galaxy as quickly as they wish...

That will help them less than one might think. In 10 minutes, a man may walk along a beach—but in his whole lifetime he could not examine every grain of sand upon it. For all that we know, there may be fleets of survey ships diligently charting and recharting the universe. Even making the most optimistic assumptions, they could scarcely have visited our world in the few thousand years of recorded history.

Man-made worlds creeping from star to star

PERHAPS, even at this moment, there lies in some rather extensive filing system a complete report on this planet, with maps which to us would look distorted but still recognizable. That report would show that though the earth was teeming with life, it had no dominant species. However, certain social insects showed considerable promise, and the file might end with the note: "Intelligence may be emerging on this planet. Suggest that intervals between surveys be reduced to a million years."

I have mentioned before how limited our picture of the universe must be so long as we are confined to this earth alone. But the story does not end there. Our impressions of reality are determined, perhaps more than we imagine, by the senses through which we make contact with the external world. How utterly different our cosmologies would have been had nature economized with us, as she has done with other creatures, and given us eyes incapable of seeing the stars! Yet how pitiably limited are the eyes we do possess, tuned as they are to a single octave in an endless spectrum. The world in which we live is drenched with invisible radiations, from the microwaves which we have just discovered coming from sun and stars, to the cosmic rays whose origin is still one of the prime mysteries of modern physics. These things we have discovered within the last generation, and we cannot guess what still lies beneath the threshold of the senses—though recent discoveries in paranormal psychology hint that the search may be only beginning. These are deep waters, and it is time to turn back to the shore, to leave the distant dream for the present reality of fuels and motors, of combustion-chamber pressures and servo-mechanisms.

The desire to give a comprehensive picture of the outcome of astronautics has compelled me to range—not unwillingly—over an enormous field. However, I do not wish anyone to think that the possibilities we have been discussing need come in this century, or the next, or the next. . . . Yet any of them may arise, at any time, as soon as the first ships begin to leave the earth. Man's first contact with other intelligent races may lie as far away in time as the building of the Pyramids—or it may be as near as the discovery of X-rays.

Of this, at least, we may be fairly certain: barring accidents—the most obvious of which I need not specify—the exploration of the planets will be in full swing as this century draws to its close. To examine them in any detail, and to exploit their possibilities fully, will take hundreds of years. But man being what he is, when his first ship circles down into the frozen wastes of Pluto, his mind will already be bridging the gulf still lying between him and the stars.

Interplanetary distances are a million times as great as those to which we are accustomed in everyday life, but interstellar distances are a million-fold greater still. Before them even light is a hopeless laggard, taking years to pass from one star to its neighbour. How man will face this stupendous challenge I do not know: but face it one day he will. Professor Bernal was, I believe, the first to suggest that one solution might lie in the use of artificial planets, little self-contained worlds embarking upon journeys which would last for generations. Olaf Stapledon has expanded this theme in *Star Maker*, one of the greatest of his fantasies, but the thought of these tiny bubbles of life, creeping from star to star on their age-long journeys, carrying whole populations doomed never to set foot upon any planet, never to know the passage of the seasons or even the interchange of night and day, is one from which we might well recoil in horror. However those who would make such journeys would have outlooks very different from our own. These speculations intriguing though they are, will hardly concern mankind in this century. We may, I think, expect that it will be at least years before confinement to the solar system produces very marked signs of claustrophobia.

Our survey is now finished. We have gone as far as is possible, at this moment of time, in trying to assess the impact of astronautics upon human affairs. I am not unmindful of the fact that 50 years from now, instead of preparing for the conquest of the outer planets, our grandchildren may be dispossessed savages clinging to the fertile oases in a radio-active wilderness. Yet we must keep the problems of today in their true proportions. They are of vital—indeed of supreme—importance, since they can destroy our civilization and slay the future before its birth. But if we survive them, they will pass into history and the time will come when they will be as little remembered as the causes of the Punic Wars. The crossing of space—even the sense of its imminent achievement in the years before it comes—may do much to turn men's minds outwards and away from their present tribal squabbles. In this sense the rocket, far from being one of the destroyers of civilization, may provide the safety-valve that is needed to preserve it.

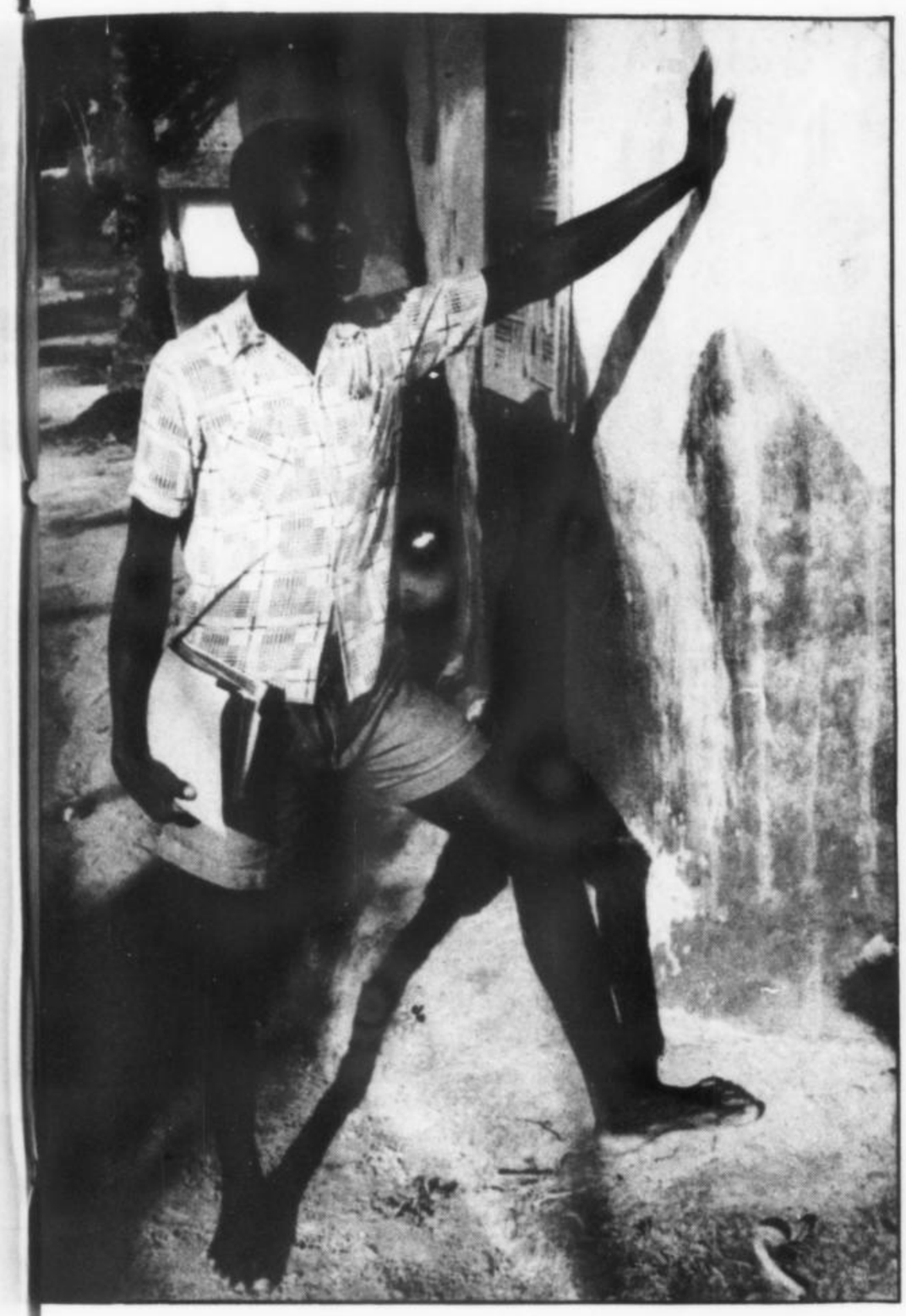
This point may be important. By providing an outlet for man's exuberant and adolescent energies, astronautics may make a truly vital contribution to the problems of the present world. Space-flight does not even have to be achieved for this to happen. As soon as there is a general belief in its possibility, that belief will begin to colour men's psychological outlook. In many ways, the very dynamic qualities of astronautics are in tune with the restless expansive spirit of our age.

Day-time dreamers are dangerous men

I have tried to show that the future development of mankind, on the spiritual no less than the material plane, is bound up with the conquest of space. To what may be called—using the words in the widest possible sense—the liberal scientific mind, I believe these arguments to be unanswerable. The only real criticism that may be raised against them is the quantitative one that the world is not yet ready for such changes. It is hard not to sympathize with this view, which may be correct, but I have given my reasons for thinking otherwise.

The future of which I have spoken is now being shaped by men working with slide-rules in quiet offices, and by men taking instrument readings amid the savage roar of harnessed jets. Some are engineers, some are dreamers —but many are both. The time will come when they can say with T. E. Lawrence: "All men dream; but not equally. Those who dream by night in the dusty recesses of their minds wake in the day to find that it was vanity: but the dreamers of the day are dangerous men, for they may act their dream with open eyes, to make it possible."

Thus it has always been in the past, for our civilization is no more than the sum of all the dreams that earlier ages have brought to fulfilment. And so it must always be, for if men cease to dream, if they turn their backs upon the wonder of the universe, the story of our race will be coming to an end.



Photos UNESCO-Eric Schwab

SPARKING COMMUNITY EDUCATION in Liberia's bush country villages is now the job of this young man (above, left) and scores like him from the National Fundamental Education Centre at Klay, near Monrovia, the capital. Graduates from training courses at Klay, where a joint Liberia-Unesco project works to improve living standards through community education, go to work in villages throughout the Republic. Above all they learn how to approach the villagers, who have been encouraged to tackle community problems and to build schools and clinics, like the model one at Amina where Dr. P.P. Mayer, of Germany (above, right) examines one of the 3,500 patients who have registered there in the past two years.

TALE OF FOUR VILLAGES

by Alexander Shaw

Mr. Alexander Shaw, a British film-maker who has worked six years for UNESCO in Africa and the Middle East, is now developing audio-visual aids to teaching in Liberia. Here, he tells the story of the establishment of a national fundamental education centre in the West African Republic.

★

THE village of Be-Sao is all that the romantic traveller could wish for. You leave the main road and take a minor one leading to one of the new rubber developments and then you leave that and follow a track through the bush and then you walk. You come to a swamp which you cross precariously on a very long bridge made of two narrow tree stems and you pass through a grove made by an enormous, soaring cotton tree. While travelling this path no woman may speak. And then you come to the village with its round mud houses and its good-looking people and its feeling of remoteness from the world and its cares.

Yet the village has its problems. A woman has a swollen and infected leg from a scratch on a nail, a baby is slowly dying because its mother is giving it the wrong food, and a man has been unconscious for two days and no one knows what is wrong. Three months ago the villagers would have begged a lift to the distant clinic for their sick and they would have got it, but it would only have helped the individuals and not the community. Now, in this first week of February 1957, they have begged that two of their women be sent away for training in first-aid and midwifery.

This request came from women who would never normally leave their homes for more than twenty-four hours.

Cont'd on next page

FOUR VILLAGES
(Continued)

Planning & patience work wonders in changing the age-old ways

The village of Weiawolo is much further. You leave your transport and you walk. You cross swamps on logs half sunk in the mud or on rickety bridges six feet above a river. Perhaps you swim if there has been rain further up and the river is ten times its normal width. You walk until the heat blinds you and you are but a pair of legs plodding along a trail on which you hope there is not a bush cow, the most feared of all the fauna of Liberia. You get to Weiawolo and they squeeze pineapples for you and you are happy that you made the journey.

Angry villagers and a closed school door

BUT on one visit the village was very angry. The school-master had not appeared for two weeks. One old and important man was very vexed indeed. Every day for two weeks he had walked three miles from a nearby village to accompany his grand-daughters to school only to find it closed.

A pointless story? Only three years ago Weiawolo had to be persuaded to build a school—and persuaded with hard argument over many days. Of course, it was a school for boys and the villagers never dreamed that a girl could possibly attend. Now they are angry because the teacher has had to go to a funeral and the school is shut.

The third village is the last of a series of villages connected to the main road by a track. You pass Vazalon and Baaja on the way to it. All the villagers grow something that they would like to send to market in Monrovia. From the point where their track joins the main road it is only one hour by truck to the capital, but it is three hours' walk to the main road and even then they may have to wait a day for a truck that can carry them and their load of cassava or coffee or fruit. Sometimes in the dry season a truck will manage to get through and buy the produce on the spot and more would come regularly if they could get there. But the bridges get broken and the rain makes swamps and for the most part the villagers either walk and chance a lift on the main road or they let the fields run down as being not worth the trouble. But this is how it was yesterday. Today trucks can run all the way in any weather. All the villagers needed was the idea that it was *possible* and a little practical help and encouragement.

These three villages are typical of thirty or forty in the Lofa-Gola-Vei territory of Liberia. Soon they will be typical of villages all over the country and this perhaps more quickly than we now suspect.

In 1949 the Liberian Government, aware that one part of the country was forging ahead of the rest, that their ever-growing rubber and mining industries needed skilled workers, that their plans for the development of the country needed educated people and that this meant teachers and that this in its turn meant educated villagers, embarked on a bold plan for fundamental education in rural areas.

Happily they started slowly. With UNESCO's aid they sent one man on an exploratory mission—then another and another. Here was wisdom, for no great onslaught is going to persuade a peasant in any country in the world that other ways may be better, that other attitudes may bring a richer life. The peasant way is a slow way and is not measured by hours or days but by crops and seasons and realities.

Gradually this pioneering work resulted in the setting up of a National Fundamental Education Centre at Klay. Again, many people from UNESCO and the Liberian Government worked hard—and how hard they worked can only be understood if you try and do something in a land where Nature fights against you with her timeless weapons of heat and rain and ever-attacking vegetation—and they built slowly but surely.

Needlework, housekeeping & ideas on women's rights

TODAY the Centre takes forty-two students from all over the country. They must have reached a certain standard at school—not necessarily a very high one—they must come from villages, and most important of all they must return to villages to work when they have graduated. This year the Centre has four women students and next year it is hoped to increase this number.

There is one important factor: the students are not boys, they are young men and they bring their wives with them. They too receive training—training in child care, in needlework, in housekeeping and in nutrition. Perhaps, too, they unconsciously acquire a certain idea about the rights of women.

The men receive training as primary school teachers so that, if it is required of them when they go to their future stations, they can open a school. They learn all aspects of fundamental education as well. Road-building, sanitation, agriculture, hygiene and first-aid go side by side with arithmetic and English and geography. Finally, they learn how to teach other people to be literate.

But perhaps the most important thing that they learn is how to approach the villagers. The dual approach to fundamental education is soundly taught: learn from the villagers things that you can take to other places, give to the villagers that which you have learned in other places.

Moses had great charm Siafe was good-humoured

WHEN the present batch of students has graduated there will be about 100 fundamental education workers spread across the country (it is not a very big country), and they will be followed every year by an increasing number of men and women who have learned simple things that could transform the whole land.

Now let us take a look at our fourth village—Ghangbanma. A surprise visit was paid to this village recently. There were two ex-students working there. At the Centre neither was particularly good, neither particularly bad. Moses had a great deal of charm. Siafe was good-humoured. Moses did indeed have a very bright wife, Fata. Siafe had no wife, at least not officially.

They had both been in Ghangbanma for four months. First of all, the villagers, although looking upon them as strangers, found them agreeable strangers. This was the important first step. Moses and Siafe had not sat down and spent a lot of time finding out the real needs of the villagers—which is one approach to the problem. They had simply put

UNESCO-Eric Schwab

ROUGH TRACK becomes an all-weather road as villagers of Dimeh, a Liberian bush village apply "self-help" with some aid and encouragement from trainees and instructors of the fundamental education centre. Previously villagers carried their produce for three hours to reach main road and then often waited an entire day for a truck going to Monrovia. Now trucks come directly from market to collect fruit and vegetables.

into practice *everything* they had learned at the Centre.

First of all they had transformed their own ordinary homes provided by the villagers, into reasonable models of what homes should be. Not ideal homes, of course, but the sort of home that any village women could achieve. Fata's children were always reasonably clean and neatly dressed, her house was clean, bedding was put out to air, food was covered and so was the water pot. Simple things about which they did not boast but just did them every day quite naturally. Then Moses built his wife a high stove and every day when she cooked the open windows were lined with people watching and commenting.

Moses and Siafe started a school. It was not a great success for a week or two; then, suddenly, the idea caught on and they had to turn away pupils from other villages. The village caught on too and cut sticks, promised labour and gave land. Very soon there will be a new school with dormitories for those children from far away. Nobody knows how the two men will run a boarding school, but they will manage.

They built soak pits for the place where their washing is done so that they do not make a small swamp every time they wash their clothes. And they built pit latrines and bath houses. They were rather clever about this as they built two types of bath houses—one for the richer people and one for the poorer. All the prosperous people built the better ones so that they could prove they were important and all the others built the other type because it was the thing to do.

'Do it yourself' teachers made education work

THE important point was that everyone used them when they were built. Moses and Siafe helped one man with his coffee pruning and everyone wanted to learn the new method. They said that the nearby bridge was a disgrace and started to repair it themselves and everyone joined in. In fact, fundamental education worked.

It is no good pretending that everyone in the village has rushed to do all these things but some have. And some will lead to many.

The Centre has been handed over to Liberian direction but UNESCO has its heart in the affair and will continue to support it by sending specialists when they are required. Indeed, two will continue to work there under the directorship of the already legendary Miss Wilhelmina Bryant. Under a UNESCO fellowship, New Zealand, Samoa, India and Egypt were visited by Miss Bryant and happily gave up the deepest secrets of their fundamental education techniques. She has taken them all, added them to Liberian methods and out of this mixture will develop still newer and more suitable approaches to the task of raising the level of understanding of her country people.

This is a chronicle of small events and you may have read it all before in a different setting. But it is the total of these small events that could change the world—change it quickly and for the better.

THE UNUSUAL WHISTLE LANGUAGE OF THE CANARY ISLANDERS

by André Classe

Lecturer on Phonetics, University of Glasgow

THE word "Speech" for most of us means a method of communication based on a system of sounds produced by the action of the throat, tongue, lips, etc. We know of course that there are other processes used for special purposes : writing, for instance, is a useful substitute in certain cases, and gestures can adequately replace vocal noises when some physical defect of the ear impedes sound-perception.

What is less well-known is that there exist in the world a number of languages which have an acoustic basis but nevertheless do not use the normal sound material of speech, that is to say vowels and consonants as we usually understand these terms. For example, in La Gomera (one of the smaller and less-developed islands of the Canary Archipelago) the inhabitants can converse by means of *articulated whistles*. For ordinary conversation they use normal spoken Spanish, but whenever distance makes speech inconvenient or impossible, they resort to the *silbo*, as this whistled form of speech is called.

The configuration of the island is such that walking from one point to another, not necessarily distant, may be an arduous and slow process. Gomera is of volcanic origin and exceedingly mountainous. It is almost circular in shape, with a high peak in the centre, the Alto of Garajonay. From Garajonay deep and narrow gorges separated by rocky ridges reach down to the coast like the spokes of a wheel. There are no plains. Moving over such ground involves the expenditure of much time and energy.

This is why the *silbo* is of such constant utility to Gomeros : a message can be whistled effortlessly over a couple of miles which it might take an hour to cover on foot. And two miles is by no means an exceptional figure. A good whistler (*silbador*) will be heard and understood five miles away or more when conditions are favourable, that is to say if there is little or no wind. I was informed that the record was fourteen kilometres, about nine miles, and any one who has heard a first-class *silbador* will realize that there is no inherent improbability in this figure.

The point is that a whistle is practically a pure tone of unchanging quality and the only significant variables are pitch and duration, so that there are no weak overtones and transients to be lost, and if the tone is perceived at all it will be intelligible. So the *silbo* scores over shouted speech in two major respects: articulation does not suffer in any way when an effort is made to increase loudness, and sounds which in speech have a low level of audibility, as most consonants have, are as easily heard a thousand yards away as at close quarters; and it is superior to visual "codes" in that it is as rapid as spoken Spanish.

There are a good many methods of whistle emission in use at Gomera. The only one never employed is the common lip-whistle which is insufficiently loud for the purpose. Normally one inserts one or two fingers, or a bent knuckle, into the mouth, the front of the tongue being immobilized, and the lips kept spread and rigid. With some practice it is possible by these means to produce a tone of astonishing loudness, purity and carrying power over a compass of some three octaves.

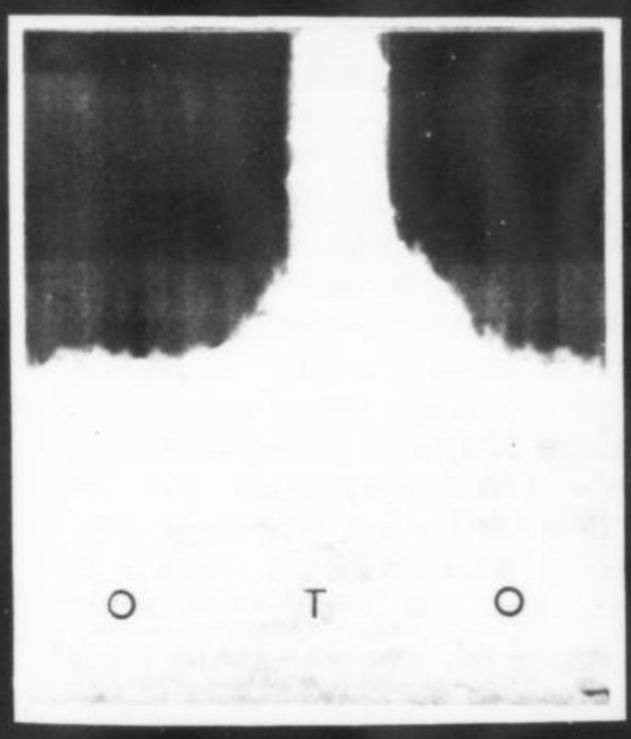
Not that this range is ever used by any one *silbador;* the limits are invariably a couple of octaves. In the east, the tendency is to whistle in the upper range, elsewhere in the lower. Some practitioners do not use the fingers at all but form a groove in the front part of the tongue which is in contact with the upper incisors, and they use the hands to form a kind of megaphone. The volume of tone thus produced is comparable to that obtained by other methods.

There is nothing very striking about all this and anyone with a sound set of teeth can learn in a couple of days to produce a sound reminiscent of a steam-whistle. What is more extraordinary is that this simple noise can be modulated in such a way as to fulfil all the functions of the spoken language, although it lacks all the variations of tone quality which one has come to regard as the very essence of speech. And this is achieved by the simplest of means. Briefly, the *silbador,* while producing the whistled tone, attempts to perform exactly the same movements with his speech-organs as if he were actually talking.

Of course his articulation is bound to differ in several respects from the normal one. In the first place the lips cannot move, so that two vowels like *ee* and *oo,* which in speech are pronounced with spread and rounded lips respectively, will have identical labial articulations; in the second place the front part of the tongue cannot move because of the insertion of the fingers, and the tongue movements are performed exclusively by the two posterior thirds of the tongue; in the third place, the glottis remains open as there is no "voicing" (some whistlers do produce a laryngeal grunt but this is inaudible a few yards away, and without significance); finally, movements of the soft palate, although they do take place, have no effect on the tone.

Normal articulation is aimed at but only a rough approximation is achieved. This is, however, quite sufficient for the purpose of complete intelligibility, and anything that can

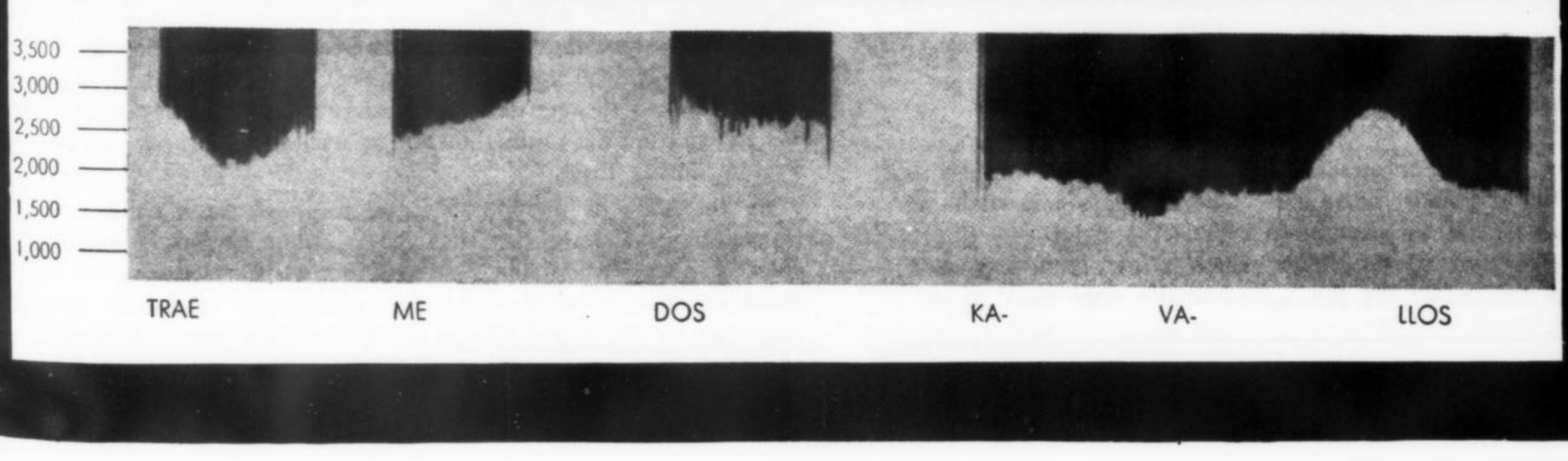
Cont'd on page 32



'BRING ME TWO HORSES', HE WHISTLED

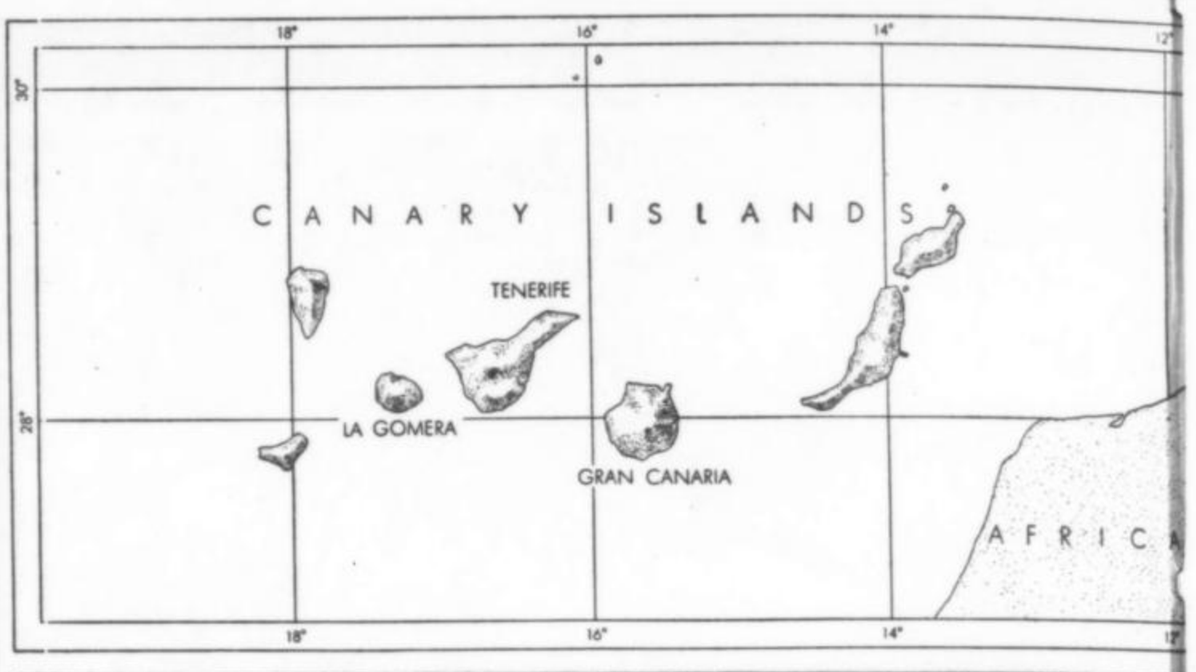
On La Gomera, one of the Canary Islands, a really first-class *silbador* (whistler) can send a message that will be heard and understood five miles away when conditions are good: (the record is said to be about nine miles). He (or she, as in photo on opposite page) normally whistles with one or two fingers or a bent knuckle in the mouth, immobilizing the front of the tongue. Position of the fingers does not affect the sound of the whistled language, whose articulation is provided by the tongue, as in ordinary speech. X-ray photograph, above, illustrates this. Whistler depresses tip of tongue whose back is raised for articulation of the vowel "u". To whistle the group of sounds "oto", (see pitch contours in graph, left) tongue starts from a low position, rises to touch the palate for the "t" and finally goes back to the "o" position. Below, electronic transcription of whistled sentence in Spanish (given in phonetic spelling) whose meaning is "Bring me two horses".

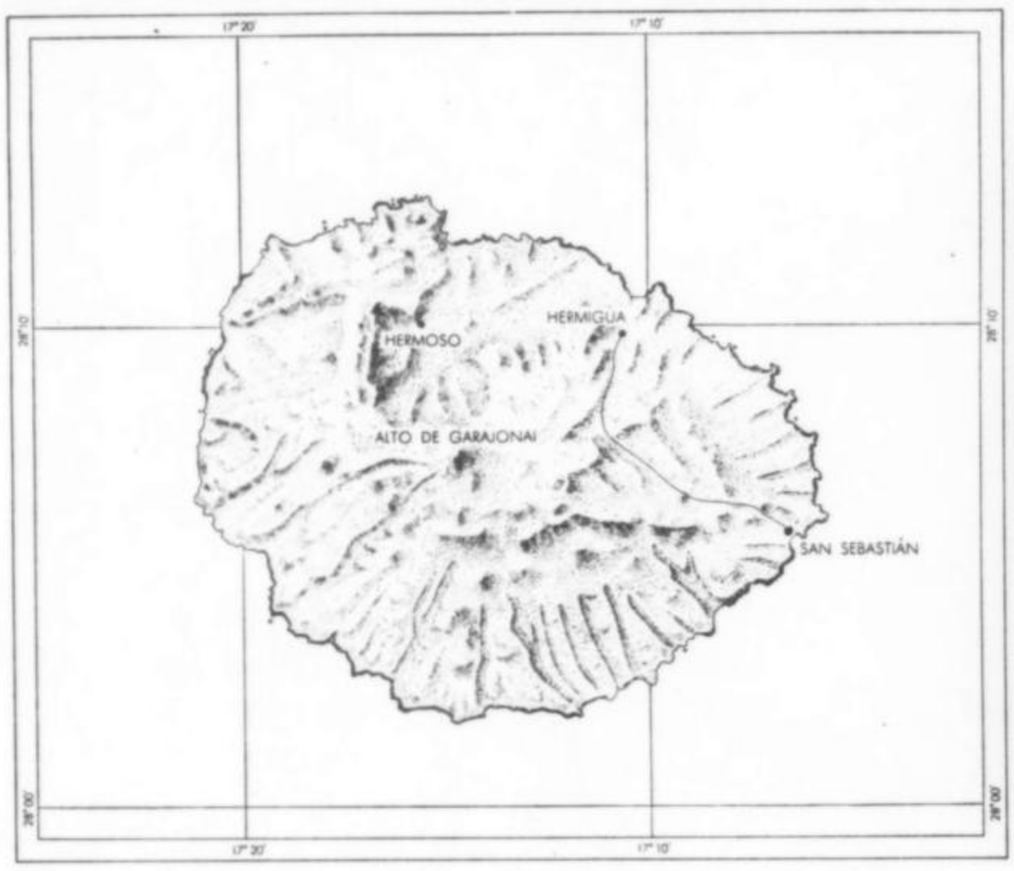
Photos André Classe

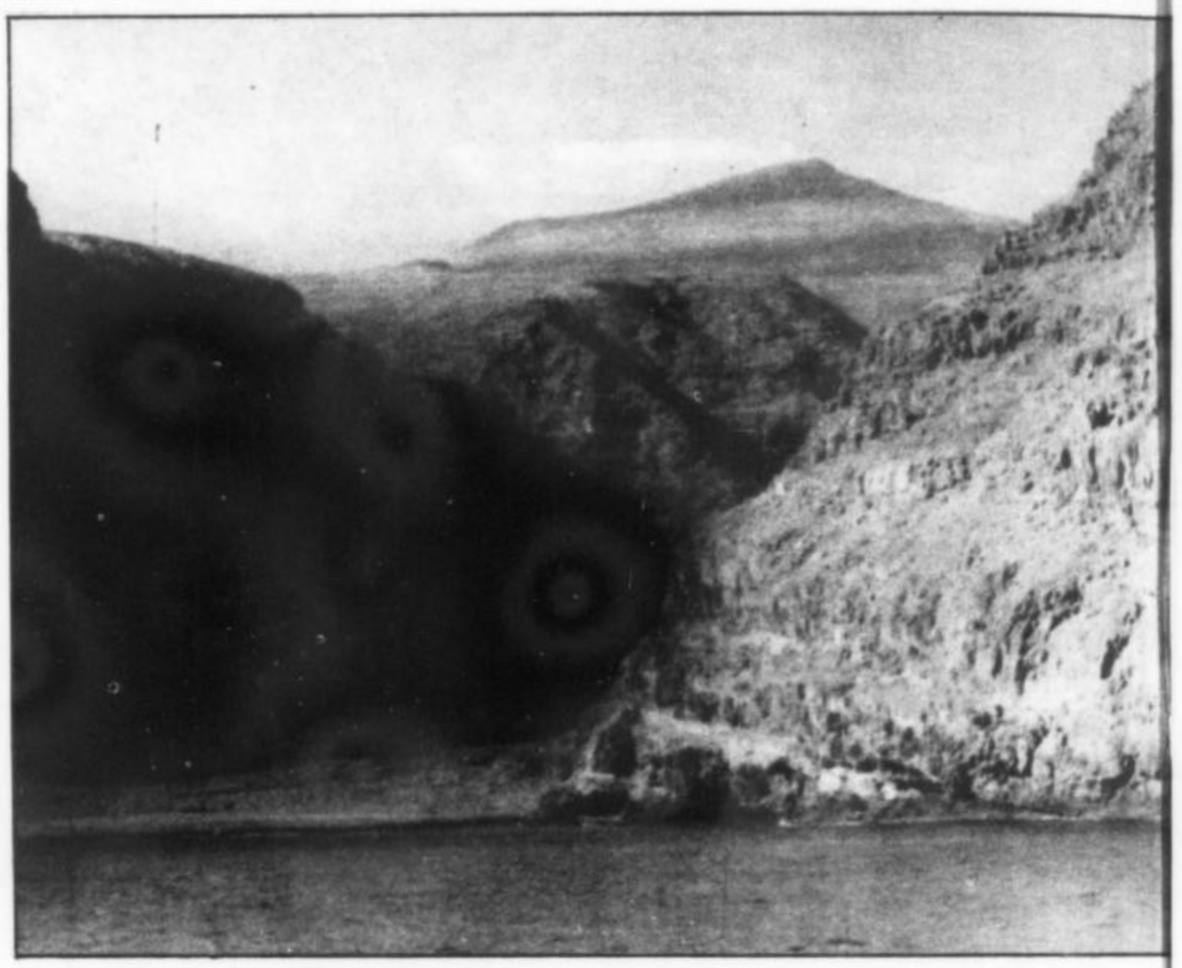


CONVERSING ACROSS MILES OF TERRAIN

The people of La Gomera, in the Canary Islands, contrived a whistled language so they could speak to each other across their steep hills and ravines. The island has the general shape of a large tent, sloping down from a central peak to sheer cliffs at the sea's edge. Deep gorges radiating from the centre cut up the terrain like the spokes of a wheel. In this difficult mountainous country two points only 500 yards apart as the crow flies may be as much as an hour apart in walking time. That is why the *silbo*, as the whistled form of speech is called, is of constant utility, enabling the islanders to converse quite easily and distinctly across several miles of terrain.







be *said* in Spanish can be whistled and understood perfectly. Without giving a complete description of the phonetic structure of the *silbo* (1) we can see how this works if we consider one or two elementary cases.

If we whistle a few notes, say doh, mi, soh, we notice that as the pitch goes up the tongue rises in the mouth. This is because the pitch of a whistle depends on the volume of air in the mouth cavity, and tongue movements cause this volume to vary. So if we attempt to pronounce the vowel *ee* (as in *beat*) the free part of the tongue rises towards the palate, reducing the size of the mouth-cavity, and the pitch of our whistle will be high. If we repeat the performance with *ah* (as in *psalm*) the tongue will go down, the cavity will become larger, and our whistle-pitch will be much lower than in the first case. Thus the tongue position associated with a given vowel will be associated with a certain *pitch* instead of a certain tone-quality for the spoken vowel.

Psalm-whistling shepherds locked out of church

THE case of consonants is somewhat more complex but fundamentally identical. One example will make this clear. If we attempt to whistle the group *oto,* the tongue starts from the *o* position, which is low, then rises until it touches the palate for the *t,* and finally goes back to the *o* position. In terms of mouth-cavity volume, this varies progressively from a maximum to zero and back to maximum. In terms of pitch we start at a low level which rises abruptly for the first part of the *t* articulaion, then the tone is interrupted by the contact tongue-palate, and finally we have an abrupt glide down to the *o* level. (See graph on page 31). In point of fact, some consonants produce very similar sound-patterns, but because of the phonetic structure of Spanish, ambiguities could only occur in isolated words. In a complete sentence the context makes everything clear, and when recordings were played back to them *silbadores* were invariably accurate in their translations.

However unlike ordinary speech the *silbo* may sound, it has in fact many of the characteristics of the spoken word. For example each *silbador* has his own individual style, as when he speaks: you can recognize him by his manner of whistling as you would from his speech peculiarities. For the Gomero, the *silbo* is clearly a perfectly natural mode of expression. It is even on record that on Christmas Day, 1862, the Alcalde of San Sebastian (the capital of Gomera) had the doors of the church locked to keep the shepherds out because they persisted in ignoring his injunction not to whistle *the words* of the Psalms during mass.

So the silbo is not purely utilitarian or useful only for transmission of elementary messages. Anything that is speakable is also "whistlable". That this should be possible, given the poverty of the material of the *silbo,* is due to the simplicity of the sound-system of Spanish, the preponderance of vowels over consonants, and the relative rarity and simplicity of consonantal groups. It would not work nearly so well with a language like English.

(1) *Such a description will be found in my article "The Phonetics of the Silbo Gomero," in* Archivum Linguisticum, *Glasgow, September,* 1957.

Letters to the Editor...

Sir,

Ever since I have received THE UNESCO COURIER I have found it most interesting and enjoyable. However, it is your issue of May, 1957 which finally moves me to write: it was superb.

Two of your articles I found of such interest and beauty that I should like to have the material in more permanent form than the pages of the magazine. "Forty Jumps Through the Universe" seems to me a most skilful and original presentation, especially valuable for teaching purposes, but fascinating to anyone. As mentioned in your article, that will be available in book form. However, I wonder if it might be possible to obtain either through you or directly from the artist, some of the wonderful pictures of Axel Poignant's "Lost in the Australian Bush"? There indeed was photographic poetry; I should be most delighted if it were possible to obtain prints of some of his pictures, especially that of the little girl with the lizard.

Even if that should not be possible, permit me to express my great appreciation for your magazine.

Paul C. Berry
Connecticut, U.S.A.

Editor's Note: Mr. Axel Poignant informs us that his photo feature "Lost in the Australian Bush" has been developed into a full-length volume with text and photographs and will shortly be available in book form under the title "Piccaninny Walkabout" published by Angus and Robertson, Sydney and London, price 12/6d.

Sir,

...I am much interested in the letters published in THE UNESCO COURIER recently... It is not conducive to world peace to make out any people or any country as having no poverty, no ignorance, no sickness, no problems, no unemployment. If you run a series of photos on mass feeding in Italy, London, etc. why not show children in America being fed on government surplus; if you picture adults learning to read and write in far-off lands, why not those attending our evening schools; if you describe diseases of malnutrition in India, why not among our mountain whites?

We must admit that there are Americans who make a show of their wealth and their standard of living but every country has those. I agree with the correspondent who suggested that your articles and pictures would make us believe that only dark-skinned races are at a disadvantage economically, in culture, in health, etc. That breeds smugness in some and envy and resentment in others, We need to develop a sense of the weaknesses and failures of our own culture and work on these even while we send CARE packages and aid to refugees...

Miss Frances Jelinek,
Milwaukee, Wis., U.S.A.

Sir,

It is always with great pleasure that I receive my copy of THE UNESCO COURIER. Each issue is a precious source of facts that every teacher should possess. I read some of the articles to my older pupils and they are shocked to find there is so much misery in the world.

The April 1957 issue dealt with the problem of hunger. As you may know Canadian children have plenty to eat; some even have four meals a day. It is far too much, isn't it? After I had read Melville Hardiment's article, "The Year the Rains Failed", one pupil wrote, "When we compare our standard of living with that of these people, we find we are favoured to the greatest possible degree. We get three good meals a day, and no one dies of hunger. But we often hear it said, 'he is ill or he has died because he ate too much'. We ought to thank Providence and think of other less fortunate people."

On page 14 of the same issue (French edition only) you say that the Canadian national dish is pea soup. My class says that it should be pork and beans and apple pie. I think they are right.

Frère Alfred-Benoit
Chicoutimi, Canada

Sir,

I am a young reader of your magazine. I find the articles extremely interesting and I like the appearance of the magazine. In the July issue which I have just received I was especially interested in the article dealing with UNESCO's work in the field of translating classical works from the Orient and the Occident. I think UNESCO should see about making direct translations into Russian of the classical works of the Orient and Asian countries. The Russian reader who does not know French or English has no chance of getting to know these masterpieces of world literature.

Askold Kourkine
Krasnoyarsk, Siberia, U.S.S.R.

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From the Unesco Newsroom...

INDIA'S FARM FORUMS: Radio Farm Forums, started on an experimental basis in Bombay State last year, have proved remarkably successful and have provided an incentive for large scale community action. The experiment was financed by UNESCO and carried out by the Ministry of Information and Broadcasting. The Radio Forums of 20 members each were organized in 150 villages, and a series of 20 special programmes were broadcast which people later discussed. The forums were enthusiastically received by the villagers and stimulated community action—from the opening of reading rooms to widespread vaccination of cattle.

■ **ATOMIC RADIATION DANGERS:** *The World Health Organization (WHO) Study Group on the Effect of Radiation on Human Heredity reports; "All man-made radiation must be regarded as harmful to man from the genetic point of view." Sources of man-made radiation are principally X-ray tubes and nuclear reactors, and artificial radioactive elements distributed by man in nature, such as waste products from reactors. Particular concern was expressed about genetic hazards of radiation from atomic materials used in medicine, industry, commerce and experimental science. The dangers of excessive exposure to X-rays is also stressed in a special issue of the WHO Chronicle, entitled "Challenge of Atomic Energy."*

MUSICAL YOUTH AT WORLD'S FAIR: For ten days next July Brussels will become the world's music capital when more than 2,000 young people from 20 countries will meet there at the XIIIth Congress of the International Federation of Musical Youth which will be held in the grounds of the great Brussels International Exhibition. An orchestra from a different country will play each evening, and the closing concert will be given by an international orchestra of young musicians from the Congress—all amateurs and all under 30 years of age. UNESCO and the International Music Council will be represented at the Congress.

■ **A WOMAN'S NATIONALITY:** *The U.N. Convention on the Nationality of Married Women has now been signed by 19 states and ratified by two—the United Kingdom and Israel. Adopted by the U.N. General Assembly last January, it will come into effect 90 days after six states have ratified or acceded to it. It provides that a woman's nationality is not affected by the fact of her marriage or by its dissolution, or a change in her husband's national status. Contracting parties also agree to speed naturalization formalities to enable a woman of foreign nationality to acquire her husband's nationality if she wishes.*

THE NEWS ALLIANCE: Major news agencies in 16 European countries recently founded the European Alliance of News Agencies with temporary headquarters in Brussels. The Alliance will encourage the wider exchange of news, promote co-operation among its members in developing news techniques, and safeguard their common interests. Members have associated themselves with UNESCO's programme to promote the free flow of information.

■ **CHEAPER POSTAGE FOR BOOKS:** *Acting on suggestions initiated by UNESCO, the Universal Postal Union (UPU) granted some new facilities for the postal despatch of books, newspapers and other printed materials, at its recent Congress in Ottowa. Under the new provisions books may be sent in packets of up to 5 kilograms instead of 3 kgs., and this may be increased to 10 kgs. by special arrangement. Books will enjoy the reduced airmail rate now conceded to newspapers. Publications for the blind will be exempt from all postal taxes and registration charges. The new provisions are expected to go into effect in October 1958.*

UNDERSTANDING EAST AND WEST: A one-week study course for journalists on the theme of East-West understanding has been organized in Zurich by the Swiss National Commission for UNESCO. The course was designed as a contribution to UNESCO's major project to increase understanding between Orient and Occident, and was open to professional journalists covering foreign news for newspapers with a maximum circulation of 12,000 copies, serving rural areas. Journalists attending the course have had an opportunity of studying various aspects of news coverage for Asian countries and the services available in Switzerland, of visiting the offices of a Swiss daily newspaper to see the documentation kept on Asian countries, and of meeting Asian press representatives and students in Switzerland.

■ **EDUCATIONAL TRAVEL CONCESSIONS:** *In response to a proposal by UNESCO, the Pan-American Railway Association at its recent Congress in Buenos Aires urged member governments and railway systems to grant the greatest possible rate reductions and facilities to educational travellers and to educational, scientific and cultural materials. Fourteen Latin American countries and the United States of America, representing the major railway systems of North and South America, took part in the meeting.*

IN THE COMMON INTEREST: Twelve years of international effort to solve common problems were celebrated on October 24, the day officially set aside as United Nations Day whose theme this year was "in the common interest." Since the charter was signed in 1945, by 51 nations, 31 other states have pledged themselves under its terms "to maintain international peace and security, and to ensure... that armed force shall not be used, save in the common interest." Six new member states have joined the U.N. since the last U.N. Day: Ghana, Japan, Malaya, Morocco, Sudan and Tunisia. Progress in the development of the peaceful uses of atomic energy is noted in the unanimous approval, by eighty-two governments, of the constitution for an International Atomic Energy Agency, under U.N. auspices.

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ORIENTAL MUSIC TOO HATH CHARMS

How can people of the West better understand and appreciate the music of the Orient? This question is discussed by Yehudi Menuhin, the famous violinist, on page 16 of this issue. Photo shows an Indian musician playing the *tanpura*, an instrument which is often used for the accompaniment of singing.

UNESCO-J. Bowers